Compressed Air Magazine

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BETHLEHEM STEEL

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ON THE COVER

THE cover picture, taken in the Huntington, W. Va., plant of The International Nickel Company, Inc., shows workmen with Ingersoll-Rand Size 400 chipping hammers removing surface defects from billets of monel and of pure nickel.

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IN THIS ISSUE

ALTHOUGH Nova Scotia's gold mines are among the oldest in North America, they have only recently adopted modern practices. Our leading article summarizes the status of its gold-mining industry and describes some of the picturesque production methods that were long in use there. Its author, W. M. Goodwin, is a former editor of the *Canadian Mining Journal*, now he is a consulting mining engineer in the section about which he writes.

●

FORESIGHT on the part of the Hartford Gas Company's operating personnel enabled that utility to give almost normal service during the devastating flood and hurricane of last month. An emergency program, worked out following the 1936 flood, functioned effectively. As a part of the plan, two gas-engine-driven compressors were installed above the crest of the previous flood. In the words of one of the company's officials, the machines "performed beautifully," and carried the load after electric- and steam-driven equipment had been rendered useless.

●

THE use of central stations for generating power is an established practice in populous sections; but the employment of a single plant to furnish current for only a few oil-well pumping motors is a comparatively new development. The inherent operating economy of a gas engine of modern design led to the adoption of that form of prime mover for the installation that is described in an article starting on page 5715.

●

INDICATIVE of the hardness of the ore at the Soudan Mine is the story that it was long the custom for a driller to place a finger on the spot where he had been drilling so as to show it to the man who was relieving him at the end of the shift. Otherwise the "hole" might have been overlooked. Soudan jasper and ore are reputed to be the most obdurate materials regularly drilled anywhere. An authentic article by a member of the mining staff on the drilling procedure that is followed there should prove of widespread interest.

●

CAPTAIN George E. T. Eyston, a mild-mannered, quiet-spoken Englishman, electrified the world when he drove a 7-ton mechanism across the Utah salt flats at a speed exceeding by nearly a mile a minute the mark he had set last year. An article in this issue, based on an interview with Captain Eyston, contains some information relating to his performance that has not been published previously.

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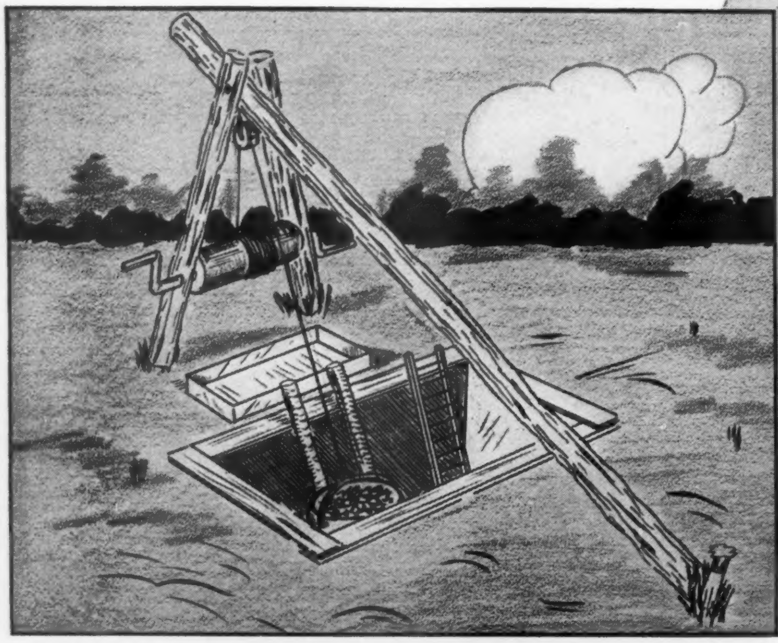
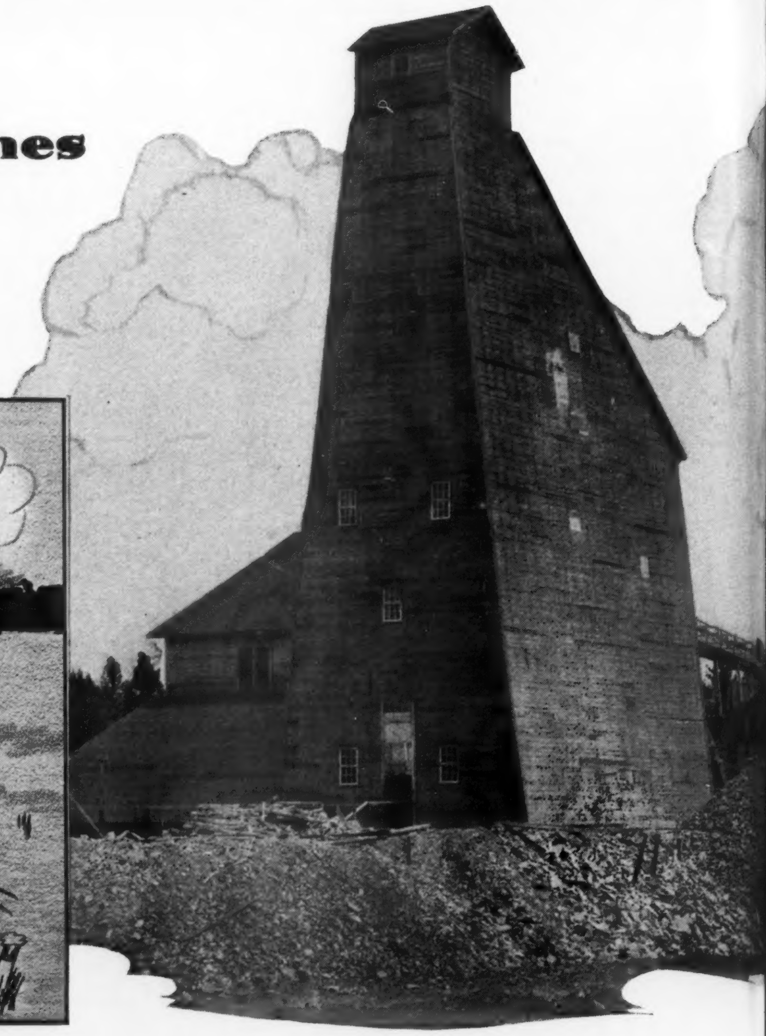
Nova Scotia's Gold Mines

W. M. Goodwin





HOLMAN SHAFT HOUSE AT CARIBOU

The Consolidated Mining and Smelting Company has recently deepened the shaft to 550 feet and erected a 20-stamp mill in which to treat the ores.

THE giant gold-mining industry of the United States and Canada as it exists today is merely an overgrown infant in contrast to the ancient gold mines of Mexico and Peru; and it compares even less favorably in relative importance and hoary antiquity with the early mines of the Old World. Still, the forty-niners of California who founded the present thriving business on this continent, and their contemporaries in the Cariboo area of British Columbia, have already become legendary. In due course, no doubt, the romance of the present era of quartz mining will be chronicled as one of the epics of progress in North America.

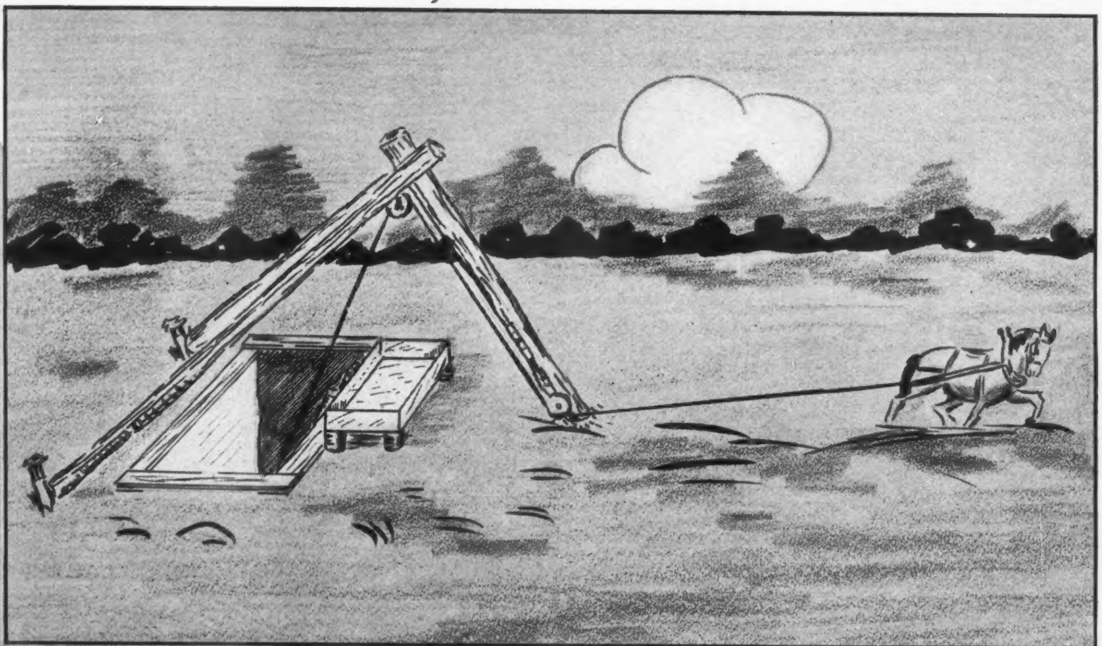
Before the placer diggings of California and the Cariboo had reached their zenith, another gold district on the opposite side of the continent had become established amidst one of the oldest settlements on the Atlantic seaboard. Little did Jacques Cartier, Champlain, and the Brothers Cabot know, as they cruised along the rugged coast of Acadia, that on the shores of some dozens of the harbors were to be found gold veins containing what in those days was fabulous wealth. But those veins remained hidden and unworked for three centuries, and then the excitement on the Pacific side of the continent set Nova Scotians searching at home for the precious metal.

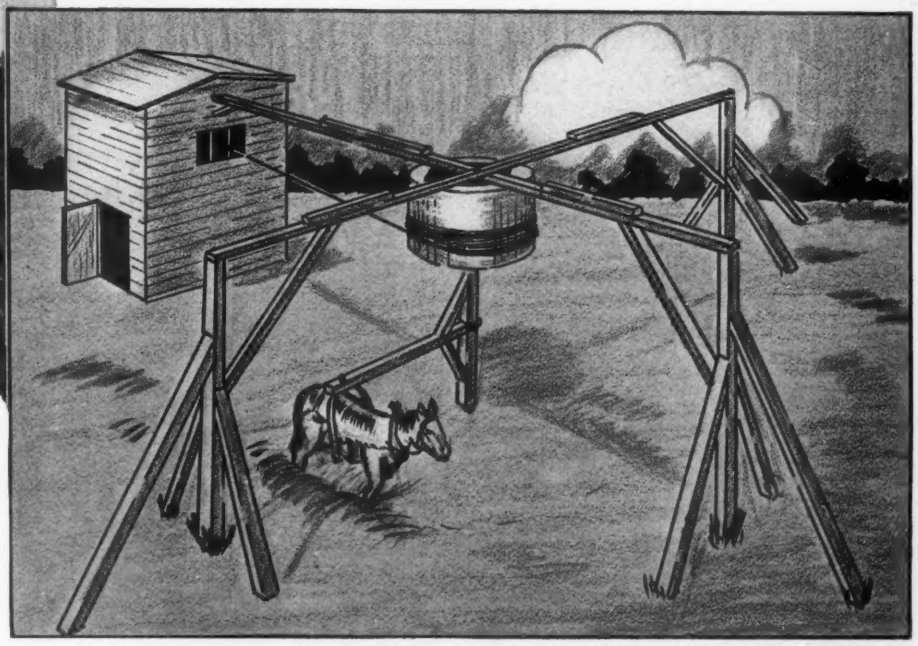
Gold was not mined in Nova Scotia until 1861, when deposits found by moose hunters at the head of Tangier Harbour and a few miles inland at Mooseland became the scene of the province's first gold rush. In the beginning the colonial government at Halifax was skeptical of it all, but was compelled to proclaim gold districts at those two places and hastily to promulgate regulations for their operation. They assumed the deposits to be placers, and modeled their legislation on what they conceived to be ideas suitable both for an impecunious government and for 1-man mines equal to the best.

The gold fever spread apace, and within a very few years gold districts had been discovered and announced at some scores of points throughout the length of the Atlantic seaboard, a distance of 275 miles. Soon the prospectors realized that half of the mainland of the province, that along the Atlantic Coast, was underlain by the gold measures, the rocks on the northern side being much younger and containing coal, gypsum, salt, and iron ores. Thus the prospectors had ample scope for their labors; and the province began to breed a numerous and vigorous race of miners who became notable for their skill and ingenuity and who since that time have spread over all this continent and beyond.

The skill of the miners was not backed up, however, by an equal competence in the management of the mines. Nor were there found any of those rare deposits that are so large and so rich that they will make mines in spite of bungling and inefficiency. The skepticism of the colonial government in Halifax about the original finds had to give way in the face of the numerous discoveries in 1860 and 1861, particularly when the possibility of taxing bullion became apparent. Inexperience of the officials led to many anomalies, some of which persisted until the last decade.

The first mining claims, for instance, were made 20x50 feet on the assumption that individual miners would work their claims as rich placers, in which case the annual rental of $20 would not have been onerous. When it became apparent that the placer gold was confined to occasional pockets on the shores, the claims were enlarged to 150x250 feet, and most of the





METHODS OF HOISTING

In the beginning, the tub was hoisted by a hand windlass (opposite page), and the ore dumped from it into a shallow tank, where water was splashed on it to facilitate sorting out lumps of waste rock. The ore was then shoveled into dump carts for transportation to the mill, which was usually located on a nearby stream and driven by water power. An improvement on this was the "horse-whip" for hoisting, and an elevated tank to aid loading of the ore and disposing of the waste (top of this page). The next step was the horse whim (above). This was an efficient and safe means of hoisting both ore and water, and in many instances the mechanical devices worked out for it were very ingenious. In the simplest designs the horse was backed to lower the tub, but in most cases a braking arrangement was provided to handle the lowering operation. The neatest attachment for the horse consisted of short traces attached to an inverted U of iron over his back with a swivel connection to the beam above. A long line of well-appointed small shaft houses often marked the course of a rich vein.

properties held today consist of such claims or "areas." Nowadays, however, 40 acres is the standard claim, and all new holdings must thus be laid out. Similarly, the rentals have been reduced to a nominal sum. In fact, the present public administration of the gold districts of Nova Scotia is one of the best on the continent.

While every part of Nova Scotia is readily accessible, compared with most of the gold camps of North America, the early miners had to contend with many difficulties. Their original ignorance of the nature of the gold deposits and of how to mine and mill the ore was soon overcome, for they were (and their successors are today) unusually quick to learn and apt in devising means to save labor and money. They are the "down-easters" of Canada, and are quite the equals of the New Englanders of a century ago who did so much for the development of the United States.

It took these self-taught prospectors only a couple of seasons to learn that the veins from which was derived rich surface float could be found, as often as not, by tracing a float northward deeper and deeper in the soil until solid rock was reached. Geologists, today, are still uncertain as to why the glacial ice did not make a clean sweep of the rock surface there as it did in the rest of Canada; but those prospectors disclosed the fact at once. Their problem then was to arrange for a mill. The first mills were set up at Tangier in 1861 and were *arrastres*. By 1863 there were several small stamp mills in the district crushing rich ore from open cuts and a number of shallow shafts. Within ten years there were scores of these little mills, usually of ten stamps, throughout the province, and these were fed intermittently with rich ore from embryo mines most of which remained in the embryo stage.

The mines themselves, however, did not keep pace with the mills. Although enough of the ridiculous little "areas" were united in many cases to form a unit of workable

SEAL HARBOUR MINE

This property has the first modern mill so far built in the province. The mine has been developed to a depth of 400 feet on ore deposits ranging from 7 to 60 feet in width; and over-all operating costs are but $2.75 a ton, the ore being remarkably easy to treat. The headframe looks out over the open Atlantic Ocean, 2 miles away.

size, still the average holding was far too small to permit of any economical, long-term development of the deposits. Another affliction was the prevalance of get-rich-quick promoters who flocked to the gold districts as fast as they were found and, more often than not, left ruin in their wake.

Still the prospectors and miners kept at their work, discovering new veins and working them down to the limits imposed by their rather primitive equipment. Holes were drilled by hand and were blasted with black powder and a "squib." The ore was hoisted with a horse whim and in a "tub" made of a cut-down fish barrel shod with strap iron. Water was hoisted in the same tub. Underhand stoping only was employed; and when the excavation was too far from the tub for the ore to be mucked into it by a relay of shovelers along the stope, then another shaft was started farther along the vein. The shaft was, in fact, only a timbered-off portion of an open stope with timber slides to direct the tub to the bottom. The long stope was kept from collapsing by lines of stulls, lagged over, called "scaffolds," and on these was piled waste rock that could be sorted conveniently at the face.

LACEY MINE

The Mines Department of the province is operating this property as a "Mine Apprentice Project." Eighty young men, chosen from among the unemployed, are receiving instruction in the various phases of mining and milling. After six months of training, they are drafted into the operating mines, where they are giving a good account of themselves. Some other Canadian mining provinces have followed this Nova Scotia plan.

The prevalent use in the mines of man power only, and of a horse for hoisting, imposed definite limitations that were not much beyond those that the miners of ancient times were forced to observe. It was impossible to develop a reserve of ore, and no one thought of keeping a reserve of money, so the hand-to-mouth mining inevitably resulted in a shutdown when the workings ran into a lean streak of ore. In consequence, the province is today dotted with literally thousands of shafts worked out to a depth of about 100 feet and (the stories of the countryside notwithstanding) with only lean ore exposed in the abandoned faces. These physical conditions, added to the discouraging record left by most of these small mines, make it exceedingly difficult to reopen the Nova Scotian gold districts now. It is true that many a modest family fortune in Nova Scotia today is based upon the returns from a rich little mine privately owned and thriftily operated; but the record available to the public tells of more failures than successes.

It is interesting to note that at the time the great empire-builder Cecil Rhodes was turning the gold mines of the Rand from the rabbit-warrens that existed near the surface into the well-ordered engineering enterprises that persist to this day there was a similar, if lesser, opportunity in Nova Scotia. Rhodes, once he had gained possession of the Rand "deeps," looked round the world of mining and found in the United

GOLDENVILLE

With a 40-stamp mill and a 600-foot vertical shaft, this famous old property, that has a greater production to its credit than any other in the province, is now being operated at a good profit. As it has a multitude of closely spaced narrow veins to draw upon, there are indications that its 75-year life will be considerably prolonged. The company obtains power from its own hydro-electric plant, located nearby. Seventy-five tons of ore are produced daily.

States the brains and the services he needed. He engaged there a group of young mining engineers and metallurgists who had learned how to put mining on a permanent basis, the main requirements being a large volume of ore, plenty of money to develop reserves of ore, an efficient and cheap mining method, and the best possible milling practice.

There was no genius to do for Nova Scotia what Rhodes did for the Transvaal. In most of the gold districts the miners carried on in the traditional way, with the simplest equipment, much of it homemade, and without either the ideas or the funds for the systematic development of ore that is the heart of the modern method of mining. In a few cases, to be sure, the properties were well equipped, and some of these had successful careers based generally on ore deposits much larger than the average even if not as high in grade.

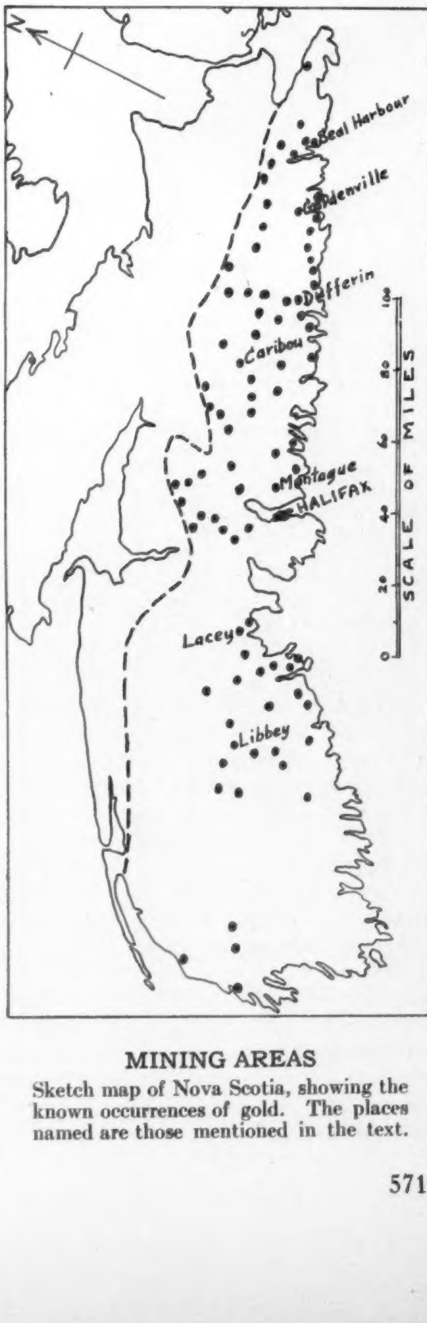
The Dufferin Mine is a case in point. A vein from 4 to 24 feet in width was worked steadily and profitably to a depth of more than 200 feet. The stamp mill on a stream nearby was run by water power, and power for the Cornish pumps and for hoisting was obtained from another fall on the same stream through a unique system of endless ropes and pulleys ¾ mile in length. The property was then sold to a company which installed an elaborate and costly steam plant and mill, sank a vertical shaft 400 feet deep to mine the assumed projection of the ore bodies, failed to find them where projected, and ceased operations.

The Libbey fissure vein at Brookfield had an interesting and profitable career of eighteen years during which the mine was extended to an inclined depth of 2,000 feet, or 1,060 feet vertically, which was quite an achievement in those days. The shoot of ore occurred at the intersections of the fissure vein with three interbedded veins, and was exceptionally consistent in size and value. As usual, no reserve of money or of ore was maintained, so when the steam hoist and pumps had reached their limit at 2,000 feet the mine was closed.

At the opposite end of the province the Boston-Richardson Mine subsisted from 1892 to 1909 on a single large saddle reef that was extracted to an inclined depth of 1,200 feet, 700 feet vertically, and supported the largest mill in the province—60 stamps, 100 tons a day—from 1900 to 1909. At this late date it was possible to provide an air compressor, a proper concentrating plant, and a cyanide plant to treat the concentrate. By means of these the total operating cost was brought down to the rather remarkable figure of $2 a ton, so that, even though little or no reserve of ore and none of money was available, the mine passed through more than one lean zone in the quartz. Finally, however, when new equipment was required at a time when income was low, operations ceased.

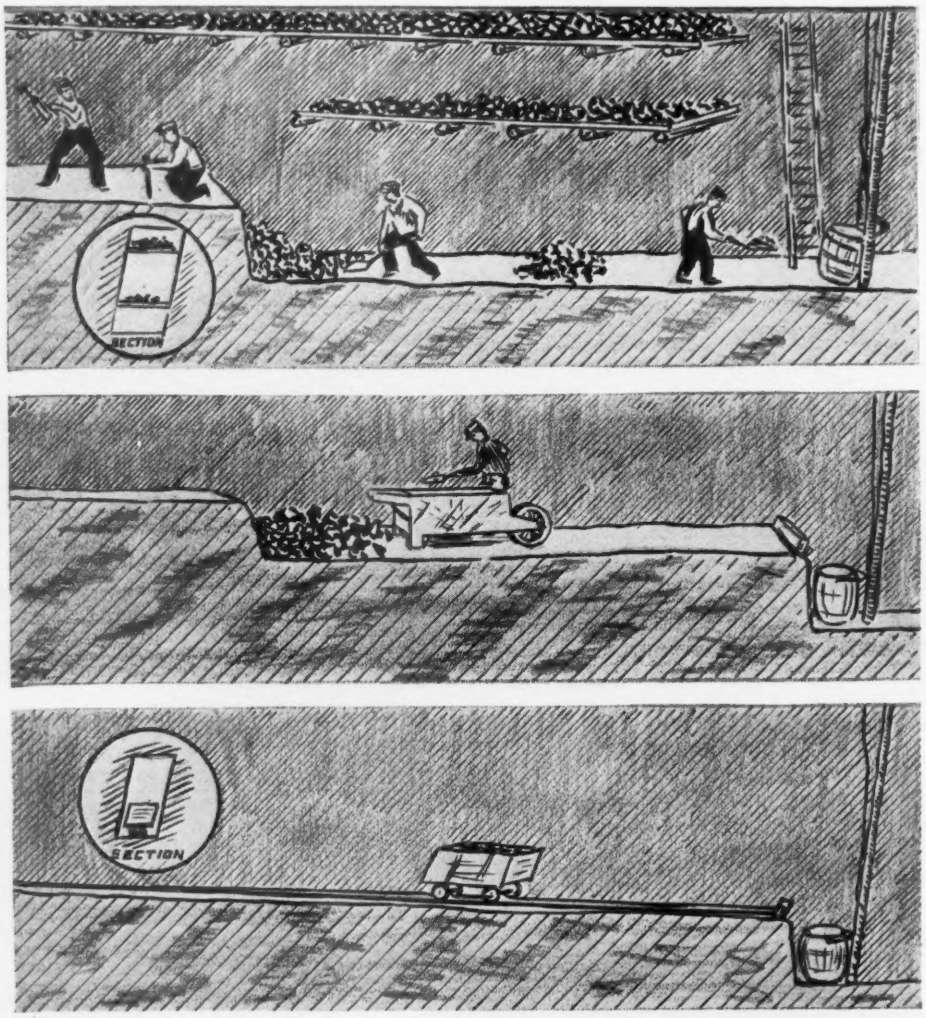
This extensive gold area, 275 miles long and averaging about 40 miles wide, with more than 100 separate districts which have at least a small production of gold on record, offers an attractive field for exploration under present conditions, and a number of well-organized mining companies are now at work there. The results obtained to date encourage the belief that, after 75 years of inconclusive efforts, Nova Scotian gold mining has at last entered upon a period in which, with modern methods, it will yield the profits which alone will make it expand and persist.

Seal Harbour Gold Mines was in the van of this new advance. After developing a series of "belts" of ore, 7 to 60 feet in width,



MINING AREAS

Sketch map of Nova Scotia, showing the known occurrences of gold. The places named are those mentioned in the text.



EVOLUTION OF UNDERGROUND HAULAGE

For many years, the ore was moved from the working face into the hoisting tub at the bottom of the shaft by hand shoveling (top). Sometimes as many as six muckers passed it on from one to another. From time to time, to shorten the distance of handling, another shaft was sunk farther along the vein. Waste rock was piled on overhead scaffolds that were erected at frequent vertical intervals. As shown in the inset, these extended clear across the narrow stopes, the accumulation of rock helping to support the side walls and to make the working places comparatively safe. All drilling was done by hand, and the miners became very skillful at swinging a hammer in the confined space. The first improvement on the line of muckers was the use of homemade wheelbarrows such as that illustrated in the center. Some of them have been preserved in the old workings. They were narrow and low-hung, with large wheels. Finally, homemade end-dump cars, running on rails made of wood and faced with strap iron, were developed. In a mine recently unwatered, the stopes were so narrow that the wooden boxes of the cars were built with slanting sides to conform to the dip of the walls, (see inset), and one rail was set very close to the footwall to keep the cars from upsetting sideways.

a 200-ton cyanide mill—the first modern mill in the province—was erected in 1936 and since then has been in continual service. It has established an over-all operating cost of $2.75 a ton, thus rivaling its famous old neighbor, the Boston-Richardson, whose 100-ton mill and $2 cost were the pride of the province 30 years ago. The old-timers, however, failed to do any appreciable amount of exploration beyond the bounds of their single ore body, whereas Seal Harbour is spending half as much in searching for ore as it does in extracting the ore that has been developed. Therein lies one of the principal secrets of successful gold mining —a fact that was unknown to the former Nova Scotian operators, or was ignored by them. Seal Harbour has a splendid mechanical equipment of diesel-driven generators, a diesel-driven Canadian Ingersoll-Rand compressor, an electrically driven hoist, a complete machine shop, and a modern mill and refinery. Seven-eighths of the gold is recovered daily as amalgam and ⅛ at the end of each month as cyanide precipitate. The ore is remarkably easy to treat, and the combined milling cost and tailing loss is 88 cents a ton—a figure that might make operators of a 200-ton mill in northern Canada green with envy.

Twenty miles to the west of Seal Harbour, at Goldenville, is an extremely interesting operation conducted by Ventures Limited, one of the principal development companies of northern Canada. In its career of 75 years, Goldenville has produced from a multitude of narrow veins lying close together considerably more gold than any other district in the province. When the Ontario company took hold of it five years ago it had a good 20-stamp mill, a 400-foot vertical shaft, and its own hydro-electric plant on a nearby stream. This equipment was used to test the numerous veins and to learn the disposition of the ore shoots in them, at the same time building up the district's first substantial reserve of ore.

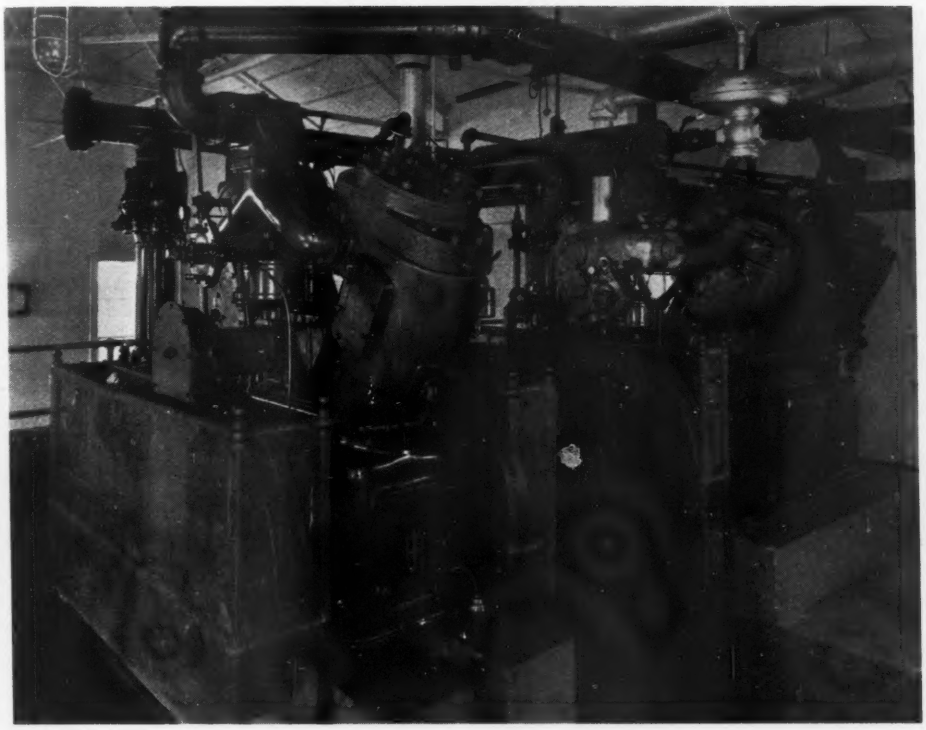
Aided by the increased price of gold, the work has been eminently successful, and the old-time plant, augmented and partly renewed, is now yielding a good profit from 75 tons of ore daily. There are literally hundreds of ribbon veins in an area 2 miles long and ½ mile wide that were formerly reached through scores of shallow shafts. They are now worked through a single central shaft which has been deepened recently to 600 feet. It seems likely that the mine as now established will have an unusually long life, as the veins cover a wide area and are not susceptible to rapid exploitation as are larger deposits.

The third substantial producer at present is the Montague Mine a few miles east of Halifax. There, also, an old stamp mill is being used effectively; but it, as well as the compressors, hoist, and pumps, are electrically driven, current being supplied by the hydro-electric station that serves the city. With the advantage of cheap power the company is making ends meet with veins only 2 to 4 inches in width. These are mined in stopes as narrow as possible, averaging less than 2 feet. Several other districts are yielding small amounts of gold sporadically with the assistance of little stamp mills.

The future of gold mining in Nova Scotia appears to rest principally on the larger deposits of medium to low grade rather than upon the tens of thousands of narrow ribbonlike veins that are the most prominent feature of the gold districts. But there are exceptions, such as at Goldenville, where the ribbon veins are so close together as to furnish an economic source of ore, and in cases like that mines of modest tonnage and of long life can be expected.

The deposits are radically different in nature from those in any other part of Canada, and nothing exactly like them is known elsewhere in the world. In consequence, the present operators have found it necessary to abandon all their preconceived ideas about the Nova Scotian gold deposits and to work out, on the basis of their increasing experience, the mining methods best suited to them. With the aid of electric power and modern compressed-air equipment they are gradually evolving methods that give remarkably low mining costs, and this, in conjunction with $35-an-ounce gold, promises to result in a flourishing gold industry in this little old province down by the sea.

Maintaining Gas Service During a Flood



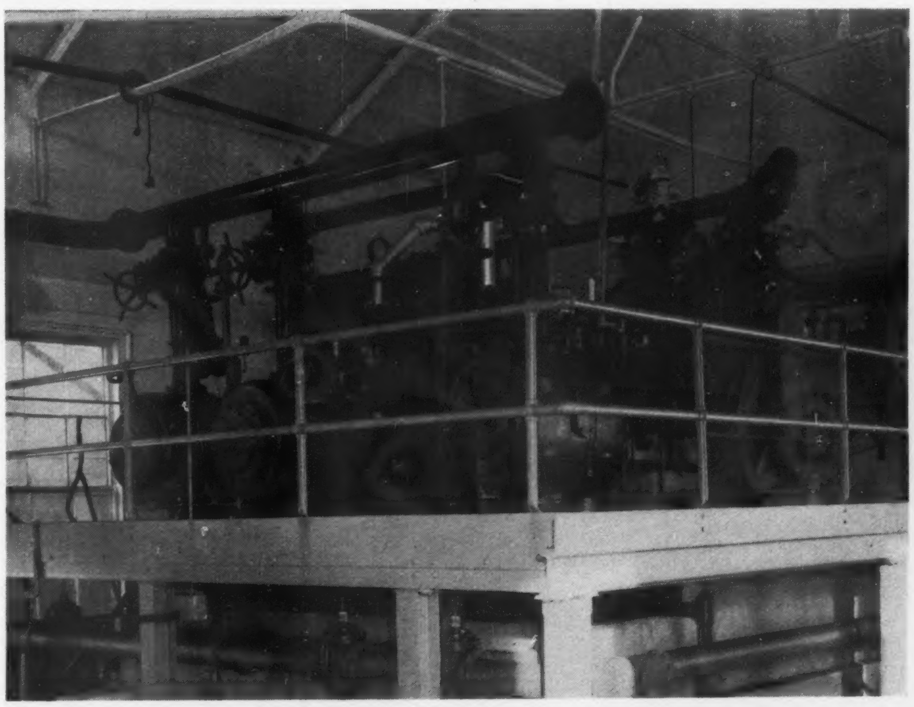
TWO years ago, Hartford, Conn., in common with much of New England, was visited by floodwaters that wrought death and destruction and paralyzed utility and transportation services. Last month floods again came to Hartford, accompanied by a hurricane of an intensity never before known in that part of the United States. Death and damage were inevitable results of the dual disaster; but this time Hartford utilities were better prepared and, consequently, rendered service that approached normal in spite of the almost impossible conditions that prevailed. Profiting by the 1936 experience they had taken steps to meet just such an emergency; and their plans proved to have been well laid.

This was particularly true of the Hartford Gas Company, which gave uninterrupted service to practically all its 50,000 customers throughout the period of storm and high water. It succeeded in doing this by setting in motion a well-rounded, carefully thought out program in which both men and machines played vital parts. Having been warned by the occurrence of two years ago that Nature might suddenly go on the rampage again, the company had worked out an emergency schedule that could be put into effect almost instantly.

Much as an army is trained to meet any contingency that may arise, the personnel of the concern was given detailed advance instructions as to how to proceed. Various officials were allotted certain directional tasks, and each department was informed as to just what its duties would be in the event conditions akin to those of 1936 had to be contended with again. That was one side of the program. The other consisted of similarly safeguarding all mechanical equipment to the end that it might continue to function under conditions as severe as those of two years ago.

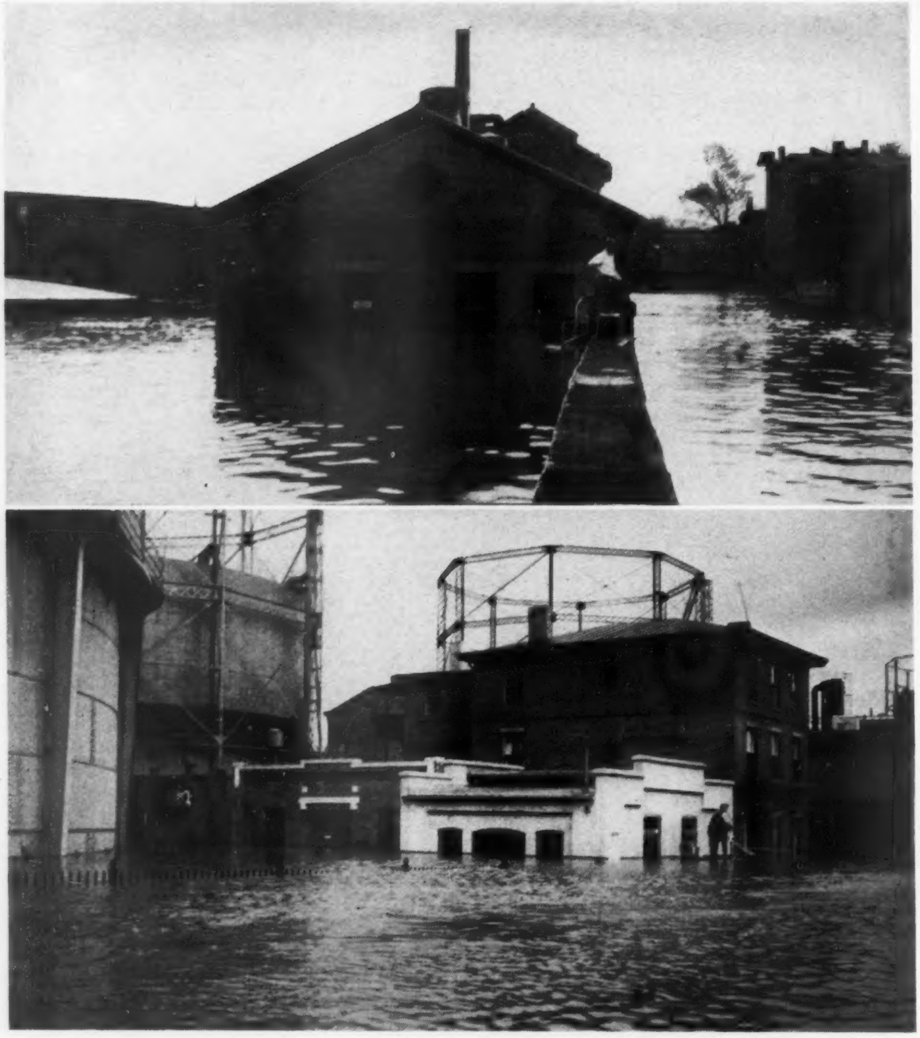
That the reader may better understand the latter phase of the preparations, we will briefly describe the physical plant as it existed in 1936 and outline the changes that were made to insure greater dependability. The company operates two plants in Hartford, one on Madison Avenue and the other on Front Street. The source of the gas supply is New Haven, approximately 40 miles away. The gas is received at the Madison Avenue plant under a pressure of 1½ to 3 pounds and, after being metered, is directed into the intermediate pressure system which feeds the low-pressure lines serving Metropolitan Hartford, any excess over hourly consumption demands being stored either in a 5,000,000-cubic-foot, waterless-type holder out of which there is some low-pressure feed to West Hartford or in distribution holders on Front Street.

At the Madison Avenue station, three synchronous-motor-driven Ingersoll-Rand compressors are used to boost pressures on the intermediate pressure line when the supply from New Haven is deficient. At



THEY PUMP GAS WITH GAS

The two Ingersoll-Rand Type XVG gas-engine-driven compressors that supplied Hartford and much of the contiguous territory with gas during the flood period. One is of 150-hp. and the other of 75-hp. capacity. The lower picture shows how they are mounted on a structural-steel-and-concrete foundation that raises them 40 feet above the normal level of the Connecticut River. This location, plus the fact that they are powered by the same gas that they send out, enabled them to carry the load of the Front Street plant throughout the height of the flood when steam- and electric-driven compressors were out of commission.



FLOOD SCENES

Pictures taken around the Front Street plant while the flood was at its crest. At the top is the office, and sections of three gas holders are seen at the bottom. The small white building is the city governor house.

the Front Street plant, gas is boosted to a pressure of 35 pounds and delivered to the Northern Connecticut Power Company, which distributes it to all towns along the west side of the Connecticut River as far northward as the Massachusetts state line. These towns include Windsor Locks, Windsor, and lesser communities. The Front Street plant in turn sends gas at 25 pounds pressure across the river to those parts of East Hartford not served by the Madison Avenue station, as well as to Glastonbury, Manchester, Rockville, and Thompsonville.

At the time of the 1936 flood, the compressor equipment at the Front Street plant consisted of two Class FR steam-driven machines and one Class ER electric-driven unit. All three were inundated and put out of commission. As the three motor-driven compressors at the Madison Avenue station also were rendered inoperative when electric power failed, the company's service was seriously crippled.

To guard against a repetition of that occurrence, the company purchased two gas-engine-driven compressors and installed them in the Front Street plant on steel-and-concrete foundations that raised their bases to a height of 40 feet above the normal level of the river. As the 1936 flood, which was the most severe on record, had reached a height of 38 feet, it seemed reasonably certain that the elevation of 40 feet would place the machines safely above the danger zone. Actually, the 1938 flood reached a crest of 36½ feet so that the water was still 3½ feet below the bases of the compressors when it was at its maximum height.

The compressors that were bought are Ingersoll-Rand Type XVG units, one of 75 hp. and the other of 150 hp. The foremost reason for acquiring them was that their gas-engine drive would render them independent in case of a possible discontinuance of electric power and steam in the event of a flood. Aside from this consideration, however, they possessed advantages that promised greater economy and flexibility of operation during normal periods. Prior to their installation, the practice had been to run the two steam-driven machines during the winter, when exhaust steam could be utilized for heating gas holders and buildings, and to use the electric-driven unit for supplemental service during peak-load periods. In the summertime the electric compressor was operated continuously; but as it could not carry the full load it was necessary also to run one or both of the steam machines, and this entailed keeping the boiler plant in operation.

Since the Type XVG's were obtained they have been used in the wintertime to supplement the steam-driven compressors for peak-load service. In the summer they operate in conjunction with the electric-driven unit to carry both normal and peak loads. Continued use of the electric-driven machine is desirable because of a demand charge for its power requirement. Besides contributing to the favorable operating arrangement just outlined, the gas-engine compressors constitute additional equipment with which to meet future increased demands for gas. The sizes of the machines and their control features are such that they can carry any load at practically full-load efficiency.

The first news of impending trouble reached the Hartford Gas Company on the morning of September 19, when Roaring Brook, swollen to spring-flood level, endangered the Manchester gas holder on the Hartford-Manchester road. By the following morning an emergency situation prevailed, and men were rushed to the location to rear sand bags around the plant to protect the governor and compressor rooms. Although ordinarily but a small stream, Roaring Brook had spread out to a width of ¼ mile and completely surrounded the station. Drips were raised, and pumps operated continuously to keep the water below the motors and governor.

Meanwhile, the Connecticut River had been rising rapidly, and on September 21 it was evident that the company would have to put in force the emergency procedure that had been drawn up previously. The boiler plant at the Front Street station, which is usually not placed in operation for the winter until November 1, was started, and a water-gas generating machine was put in service so that gas might be available in the event the supply line from New Haven failed. Actually, this line continued to function and, even though the compressors at the Madison Avenue plant had to be shut down because of electrical difficulties, service normally rendered by them was kept up by increasing the send-out pressure at New Haven.

Twelve crews were sent into the flood district on both sides of the river on September 21 to remove meters and to plug supply lines ahead of the rising water. By the following day they had brought in 1,000 meters. As the flood was by then endangering the company's service building, ranges, refrigerators, water heaters, fittings, 300 new meters, and all automotive equipment and garage supplies were shifted from it to a vacant lot on higher ground.

By four o'clock in the afternoon of Sep-

COMPRESSOR HOUSE

The two gas-engine-driven compressors that are illustrated on a preceding page are housed in this structure. The picture was taken during the height of the flood. A black line at the right end of the building indicates the level reached by the water in 1936 when it rose 38 feet, as compared with 36½ feet last month.

tember 21 the water had risen to a height of 18 inches on the sides of the waterless-type gas holder at the Madison Avenue plant. This was 6 inches above the safe level. By means of a fire hose, water was run into the holder through drip connections until it was 5 inches deep. This was done to equalize the pressure of the water underneath in order to prevent buckling of the sheet-steel bottom.

The hurricane struck about 3:45 that same afternoon, and reached its greatest intensity about 45 minutes later. Trees, telephone poles, and wires were blown down throughout the entire area, rendering streets dark and practically impassable. In Glastonbury, falling trees tore up and broke a 6-inch gas main, necessitating shutting off the supply to the lower part of East Hartford and to Glastonbury, affecting about 1,200 customers. Crews were dispatched to repair the break and to shut off meters; but because of the flood and of other breaks service was not resumed until four days later.

In the meantime all equipment and effects had been removed from the basement auditorium at the company's main office, as it had become evident that the water would probably reach it. By the afternoon of September 22 the Front Street plant and the service building were without electric power and telephone service. The steam-operated compressors at the former location were under water. At that time the two Type XVG gas-engine-driven units, mounted safely above flood level, were started. They functioned with full effectiveness throughout the remainder of the emergency period and supplied gas to the Northern Connecticut Power Company and to all the territory east of the river that had not been flooded, including Manchester and Rockville. Such a continuation of service was out of the question in 1936, and would, of course, have been impossible this year had it not been for the installation of the new compressors.

It goes without saying that innumerable difficulties had to be overcome to maintain operations. Shifts of men in boats uninterruptedly pumped all drips around the holders and yards to keep the water out. To permit this, drip risers had been previously extended to the level of pumping platforms, this having been one step in the emergency program laid out in 1936.

The accounting division of the company was housed in a large office building where power was available. To maintain telephone contact for the Front Street plant, a messenger shuttled back and forth in a boat from the Hartford Times Building about ¼ mile away. As a part of the planned program, a gas-engine-driven generator set had been installed in the business office of the company at Manchester. As a result, that office had the only lights in the business section of the city and, during the night of the hurricane, became the headquarters of the Red Cross and Chamber of Commerce. The company's direct telephone line between Manchester and Hartford was the only one functioning, and it was placed at the disposal of the relief agencies, the state police, and municipal authorities. Later on, radio became the only means of contact with the outside world, and three sets were installed in the Manchester office and tuned in to different stations to receive reports on conditions elsewhere in New England. In Hartford, after the regular source of electricity had failed, current for maintaining telephone service was obtained by running wires from the headquarters division of the Hartford Fire Department across the roofs of intervening buildings to the telephone company's offices.

Throughout the flood period, everyone in the Hartford Gas Company, from Pres. Norman B. Bertolette down, was on the job long hours every day, but schedules had been arranged to permit all to get the necessary rest. Company officials express the belief that the program mapped out as a result of the lesson learned in 1936 saved the concern thousands of dollars.

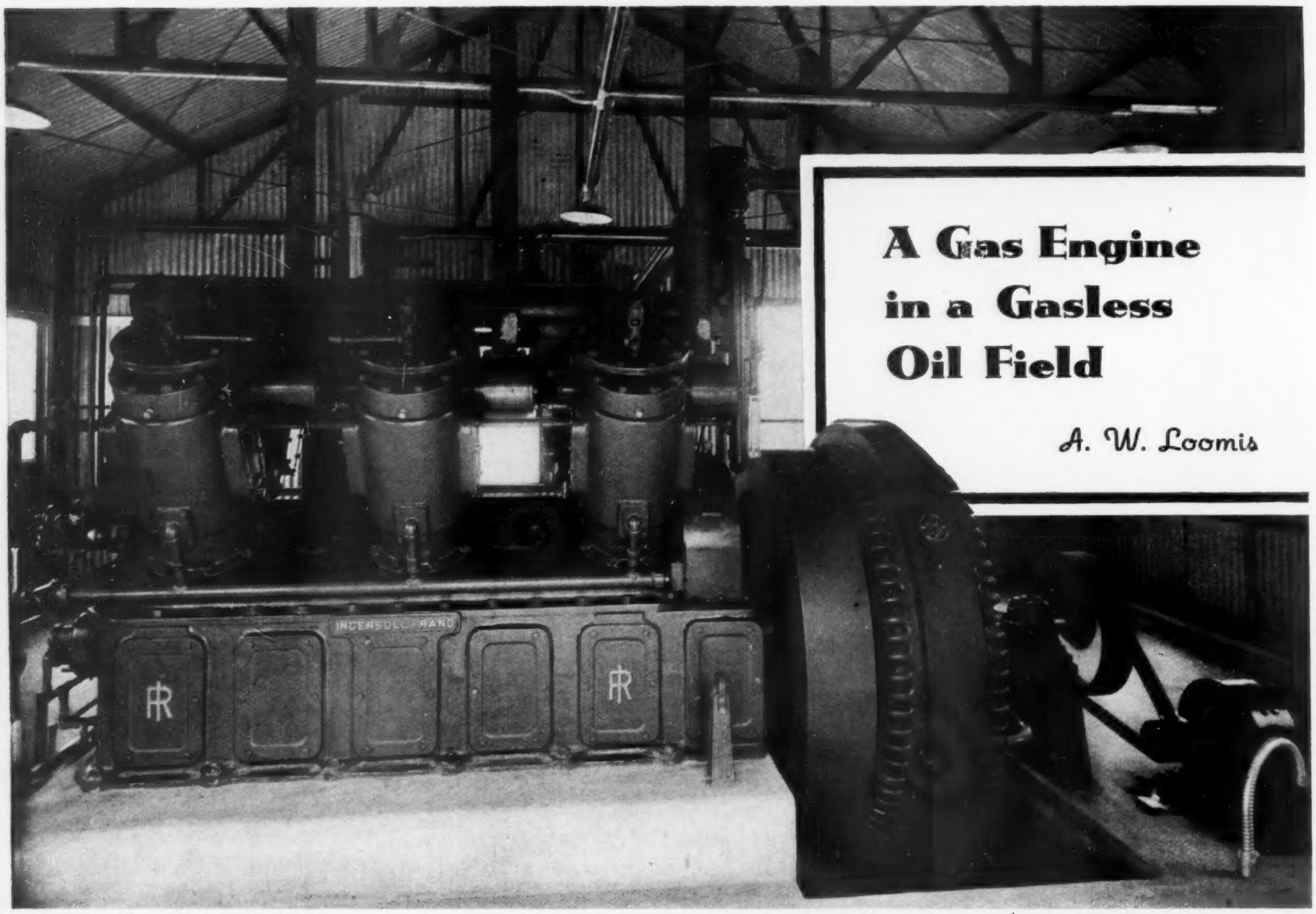
Other utilities exerted almost superhuman efforts to insure as much service as possible under the circumstances. The Hartford Electric Light Company, like the gas company, had taken steps in advance to minimize service stoppages, its total outlay for flood protection having been around $500,000. Included in these precautionary measures was the waterproofing of its South Meadows steam-generating plant to the 40-foot level and the erection of a new Pearl Street substation that was safeguarded against flood up to the same height. In an effort to restore damaged lines and structures as quickly as practicable, the company put a force of 350 linemen in the field, some coming from as far west as Kansas and Michigan.

PUMPING DRIP CONNECTIONS

To make it possible to pump condensate and water from drip connections, risers previously had been extended upward above the level of the 1936 high-water mark and platforms had been erected. The pumping crews reached these stations by boat.

A Gas Engine in a Gasless Oil Field

A. W. Loomis



THE GAS-ENGINE GENERATOR

This unit furnishes all the power required by the eleven pumping oil wells on the Stroube & Stroube lease. It is a 275-hp. Ingersoll-Rand Type PVG engine with six cylinders arranged in three pairs of two each. The generator is a 480-volt, 60-cycle, alternating-current machine of General Electric manufacture. The belted exciter is shown at the right. The circulating water pump also is driven by V-belts from the same pulley. It has a capacity of 200 gpm. against a 20-foot head.

THREE years ago the Town of Talco, situated about 60 miles from the northeast corner of Texas, had less than 300 inhabitants. Then oil was discovered, as has happened in the case of many another Texas town, and its population increased fivefold in a few weeks' time.

Drilling of the discovery well, known as No. 1 C.M. Carr, was begun late in 1935. On February 1, 1936, oil was struck at a depth of 4,208 feet and filled 800 feet of the well. About six weeks later—on March 18—it was completed and put into production as a pumping unit, producing 552 barrels the first 24 hours. It was then decided to deepen the well. In June the hole had been put down to a depth of 4,260 feet, at which it became a flowing well yielding 725 barrels in 24 hours by both flowing and pumping. Subsequent drilling proved the field to be comparatively small in extent—some 1½ miles wide by about 8 miles long. A remarkable feature of the field is that there is very little gas.

Pressures at the bottom of the wells, known as bottom-hole pressures, were between 1,800 and 1,900 pounds per square inch. This was barely enough to cause flowing, and pumps were applied to them as soon as they were completed. Temperatures at the bottom of the wells averaged about 149°F., while the initial boiling point of the crude oil under atmospheric pressure was 146°.

The crude oil itself is a heavy, low-gravity, asphaltic-base petroleum, almost black in color. It has a specific gravity of about 0.92, corresponding to 22° API. Its viscosity is 200 S.S.U. (Saybolt Seconds Universal) at 100°F. and 115 S.S.U. at 130°. For the benefit of those to whom this terminology is unfamilar, it may be stated that the oil is similar in viscosity to S.A.E. 10 automotive crankcase oil. In color it is much like automobile oil that has been used in the engine for a considerable period.

Under distillation, the Talco crude oil breaks down as follows:

Gasoline (under 60 octane)	10 to 13%
Kerosene distillate	8 to 12%
Gas oils	25 to 30%
Asphaltic residue	37 to 50%
Distillation loss	1 to 1½%

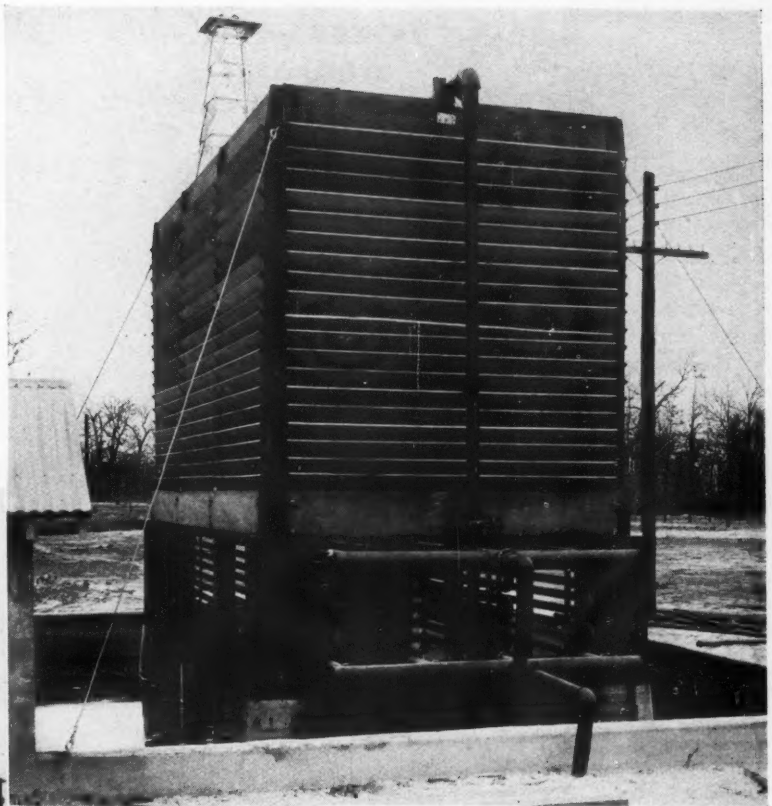
It will be noted that the gasoline content is comparatively small. However, there is a high content of asphalt, and this is of a premium grade that is found in very few places in the United States.

The Talco field, being in and around the Town of Talco, was owned by a considerable number of people, no one of whom controlled any great percentage of it. In less than a year after the discovery well was drilled there were more than 400 operators in the district. Toward the northern end of the field, on a flat covered with oak trees, the concern of Stroube & Stroube has a lease of several acres on which eleven wells have been drilled. The oil in this portion of the field is slightly above average in specific gravity, and the operators are not beset with the large volume of water produced with the oil elsewhere in the area.

The Stroube & Stroube lease is one of the few in the field on which the pumping units are driven by electric motors. Electricity is generated by a gas-engine-driven generator and transmitted by overhead distribution lines to the eleven wells scattered throughout the area under lease. As there is little gas in the field, the engine is operated with purchased gas piped in from an outside source. The gas engine is an Ingersoll-Rand Type PVG 6-cylinder, 4-cycle unit oper-

PUMPING WELL AND COOLING TOWER

Below is one of the oil-well pumping units showing the walking beam, gear drive, and motor. The weight of the sucker (pumping) rods that go down in the well is balanced by variable counterweights on the gear drive. At the right is the tower for cooling the engine circulating water. The discharge from the engine jackets enters the coils at the base of the tower and passes successively through the various banks to the top, from which point it is returned to the engine. It is cooled by water pumped from the pit and sprayed over the coils. This water, in turn, is cooled by evaporation and radiation as it descends through the tower.



ating at 400 rpm. and rated at 275 hp. It is direct connected to a General Electric 480-volt, 60-cycle, alternating-current generator that supplies current for the oil-well pumping units, for a motor-driven water pump, and for the lights on the lease.

The PVG engine is identical with the power end that has been successfully used for several years on the I-R Type XVG compressor which was designed primarily for oil-field service and of which installations totaling nearly 150,000 hp. have been made. One of the pictures shows the V-type cylinder arrangement, a structural feature that largely eliminates torsional vibration and makes for smooth and economical performance. The multi-cylinder arrangement also divides the load and permits the use of smaller parts and thinner wall sections, resulting in quick and effective cooling.

An extension shaft on the generator carries a V-belt pulley from which are driven the exciter for the generator and the engine cooling-water pump. This pump is a Cameron 4-CRVL unit which is rated at 200 gpm. against a head of 20 feet. It circulates water through the engine and cooling tower. The latter is of the conventional spray type and about 20x30 feet in size.

A small pump house is located next to the cooling tower. In it is a 7½ hp. 2-RVS Motorpump rated at 350 gpm. against 60 feet of head. It takes water from a pit at the base of the tower and delivers it to sprays at the top. On its return to the pit it runs over and cools the coils through which the engine cooling water is circulated in a closed system.

On an instrument panel on one side of the engine room are mounted a voltmeter, an ammeter, a cycle indicator, and a circuit breaker. There is also a series of small red lights—one for each well. These lights are controlled by a mercury-type switch on the walking beam of the well pumping unit. When the pump is operating the light connected to it blinks continually, telling at a glance which wells are working.

Air for starting the engine is furnished by a 4 & 2½ x 2¾-inch Type 30 compressor driven by a gasoline engine. Two 11-cubic-foot receivers used in connection with this compressor are located just outside the engine room. Air for the gas engine is brought in from the outside through a pipe the intake end of which is equipped with a Vortox wet-type oil-bath filter.

Each well is operated by a Lufkin walking beam which is V-belt driven through an Oil Well Supply Company gear pumping unit having a ratio of 29.4 to 1. The wells are pumped at about 15 strokes per minute. The driving motors, each of 40 hp., operate at 1,160 rpm. and are provided with main line, disconnect, compensator switches.

The discharge from each well goes into a line leading to a small settling tank. There the water and impurities are allowed to separate, after which the oil is pumped into a storage tank from which it is collected at regular intervals by the pipe-line company operating in the district.

Only one man is required to operate all the wells on the lease. When the main switch is pulled at the electrical plant, the pumps at the various wells stop and automatic switches fall out, so the operator does not have to go to each well to shut it down.

While the first cost of an integrated electric pumping system of this type is somewhat higher than that of the usual arrangement, consisting of small individual pumping engines for each well, the operating costs are considerably lower. It is therefore possible to retire the original investment from the savings in a fairly short period.

The Soudan—a Hard Rock Mine

*W. P. Wolff**

THE Soudan Mine of the Oliver Iron Mining Company, on the Vermillion Iron Range, near Tower, Minn., is distinguished in a number of ways. Not only is it an old, dependable producer of high-grade, lump iron ore, and the oldest and deepest mine in the State of Minnesota, but it also enjoys the unenviable reputation of having the hardest ground of any mine on the continent to drill and break. To the mining fraternity at large, the Soudan's chief claim to distinction is the very tough drilling problem that it offers. For many years it has been an object of interest, study, and visit for mining engineers from every part of the world. Likewise for many years it has been a favorite proving ground and finishing point for research and test for explosives, rock drills, and drill steel.

All drilling at the Soudan is done with detachable bits, of which between 2,700 and 2,800 are used each day. These are of a heavy type of crossbit, 2 inches in diameter when new, double tapered, with center hole, and with a cutting-edge angle of 105°. They are reground and retempered in the mine drill shop so that each bit is used eight times. Bits are discarded when they reach a diameter of less than 1⅝ inches. Drill rods are of 1⅛-inch diameter, round, hollow steel, are threaded for the bits, and have standard lugs. The drill machines in service are drifters of 3- and 3½-inch piston diameter, and are operated with air at 80 pounds pressure. All those purchased recently have automatic feed.

It is the practice at the Soudan to divide the ground broken in the mine into three classifications: rock, jasper, and ore. As a drilling problem, interest is focused principally on the last two. However, for the sake of completeness and comparison, the first also is included here. The rock is popularly, though not quite properly, called greenstone. It comprises a considerable variety of metamorphic rocks, chiefly quartz-sericite schists, sericite schists, chlorite schists, and combinations of the three. These are roughly divided into yellow and green schists, and are the metamorphic equivalents of ancient acid and basic flows and of acid intrusives. There are subordinate amounts of schists derived from sediments, including quartzites and some carbonaceous slates. Some basic intrusives are identified.

Records from January to April, inclusive, 1938, show the following average footage drilled per month in each class of material: in ore, 7,511 feet; in jasper, 929 feet; in rock, 7,634 feet. It may be noted that the footage in ore is low and in rock high, comparatively speaking. This is attributable in part to the fact that the back-stoping method of mining in use permits placing holes so as to break a relatively large amount of ore per foot of hole, and in part to the large amount of rock drilling that is required to provide fill for certain stopes. It goes without saying that, whenever conditions permit any choice in placing holes,

*Chief Engineer, Vermillion District, Oliver Iron Mining Company.

DRILLING IN A SOUDAN STOPE

A view that gives an idea of the appearance of the ore, which in some places is actually as hard, by Brinell test, as the bit of the drill steel. The latter can penetrate it only because it is the tougher of the two. The drillers shown (one at the left is faintly visible) are using L-74 drifter drills with automatic feed. All drilling is done with "Jackbits," of which between 2,700 and 2,800 are used daily. When purchased, all are of 2-inch diameter. By regrinding and retempering them, each bit is used eight times. They are discarded when they are worn down to a diameter of less than 1⅝ inches.

SCRAPING ORE INTO MINE CARS

This untimbered stope in solid ore is 50 feet wide, 275 feet long, and 22 feet high. After being drilled and blasted, the ore is loaded into cars by means of a double-drum electric hoist which operates a scraper, as shown here. The Soudan Mine was opened in 1882, and the first shipment of ore was made on August 1, 1884. The hard, practically pure hematite ore is used principally in the manufacture of open-hearth steel. Being heavy, the ore breaks through the slag into the molten bath of metal in the furnace, thus supplying the necessary oxygen for the regulation of the carbon content of the steel.

drilling in jasper is avoided. Hence the small footage in that material.

As regards drilling, the rock presents no difficulty. It is just average rock. The average penetration per bit is 22.1 inches. Different parts of the mine report penetrations ranging from 13.5 to 45.6 inches per bit over a considerable period. Penetration per minute of operating time averages 1.9 inches, with different localities reporting penetrations ranging from 1.51 to 2.45 inches per minute over a considerable drilling period.

The jasper is the lean iron formation. Petrologically, it is the product of complete dynamic metamorphism of an iron-bearing sediment. In composition it consists almost entirely of iron oxide and silica, and may contain from 10 to 50 per cent of iron. In appearance it is striking. The bluish-black iron oxide—in the form of nearly pure hematite, usually crystalline—is in layers a fraction of an inch thick, alternating with layers of silica in various shades of red. The silica is finely crystalline quartz ordinarily containing included iron oxide which gives it the characteristic red color. The jasper is commonly folded intricately, and the alternating layers of contrasting dark colors, often traversed by bands of white vein quartz, present patterns of remarkable beauty when cut in section.

Composed of two very hard minerals, intimately knit together by complete recrystallization, the jasper is the hardest rock of this premier of hard-rock mines. To the operator or engineer, the penetration figures tell the story most simply and accurately. The average penetration per bit is 1.77 inches, with penetrations ranging from 1.16 to 3.22 inches per bit. The penetration per minute averages 0.383 inch, with penetrations in different places over considerable drilling periods ranging from 0.21 to 0.747 inch per minute.

The ore itself is practically pure hematite. Some of it consists of a breccia of dense hematite fragments cemented together with more coarsely crystalline secondary hematite. This is the least hard of the ores. Other ore consists of bands of dense hematite between bands of coarser crystalline hematite, which apparently replaces the silica bands of the parent iron formation. Still other ore is very dense, massive hematite showing no original sedimentary texture and with its crystal components of microscopic size. This is the hardest of the hard ore. The ore is sometimes contaminated with small veins of white quartz. In mass, the ore has a few parting surfaces which tend to be horizontal. These often aid in breaking it, but are avoided in drilling.

In its resistance to drilling, the ore is only slightly less hard than the jasper. Here again the figures tell the story. The average penetration in ore per bit is 2.25 inches, with penetrations ranging from 1.01 to 8.68 inches per bit in different places. The penetration per minute of operating time averages 0.388 inch throughout the entire mine, with averages in different parts and over considerable drilling periods ranging from 0.154 to 1 inch per minute.

The operating time in figuring penetration per minute is all the elapsed time from the instant a drill is set up ready to run until it is ready to be taken down after the completion of drilling from a given position. It includes all ordinary delays.

It is to be noted that there is a wider range in the hardness of the ore than there is in the jasper, and that the rock is more uniform than either the ore or the jasper. It should also be noted that the variations in penetration in each case are averages covering considerable drilling, and that in all three types, especially in the ore, variations much greater than those indicated are often encountered. As an illustration, a single hole that was recently reported required the use of 103 bits to drill 36 inches. Wide variations in hardness are frequently observed in adjacent holes and even in a single hole.

The figures given are taken from the drilling records of January to April, inclusive, 1938. For ease of comparison, they are tabulated, together with other data obtained during the same period:

	Drilling in		
	Ore	Jasper	Rock
Penetration per bit, inches	2.249	1.766	22.130
Penetration per minute of operating time, inches	0.388	0.383	1.901
Drill bits used in four months	160,439	25,826	16,559
Feet drilled	30,046	3,718	30,536

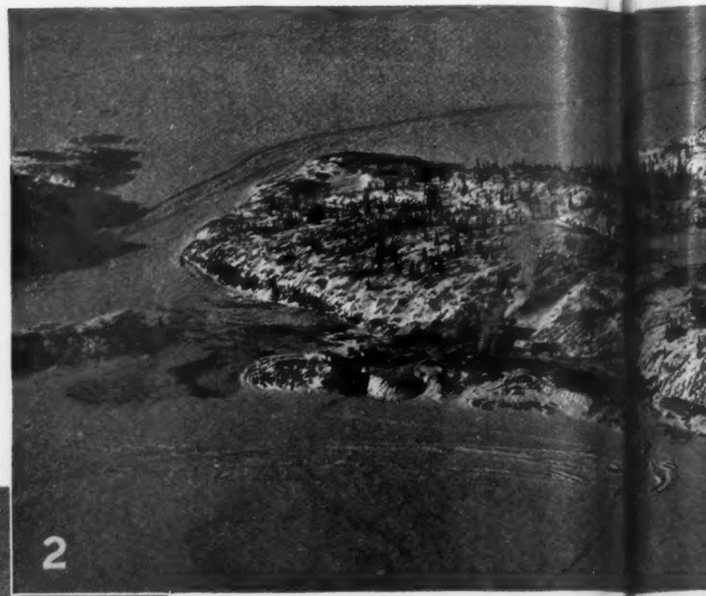
The foregoing statements and data give a good idea of the hardness of the jasper and the ore in the Soudan Mine. Further analytical evidence offers added emphasis. For instance, Brinell tests have shown specimens of the ore to be actually harder than the steel that was used to drill it. It would seem that the steel survives only because it is tough, while the ore is relatively brittle. Indeed, plenty of instances have been noted in which the ground particles from the drill bit, itself, constituted an appreciable proportion of the total breakage at the bottom of the hole.

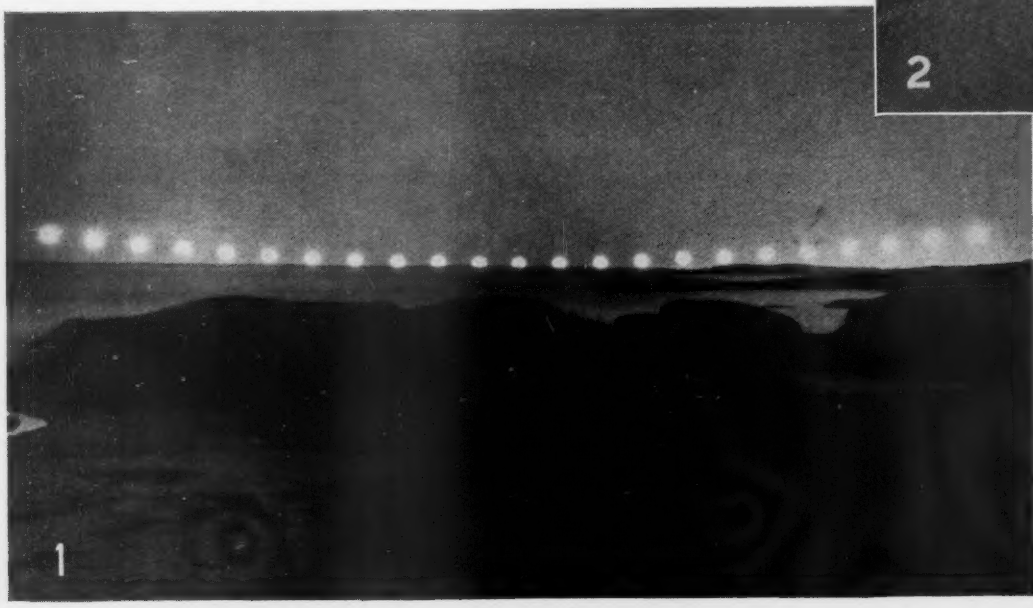
The statement has been made by men qualified to know that the Soudan jasper is the hardest rock that is regularly drilled in any commercial operation. This is a sweeping statement, which may or may not be literally true. But, one way or the other, the jasper has been for years and still is a challenge to the best of the rock-drilling craft; and in hardness, the Soudan ore, itself, differs from it but little.

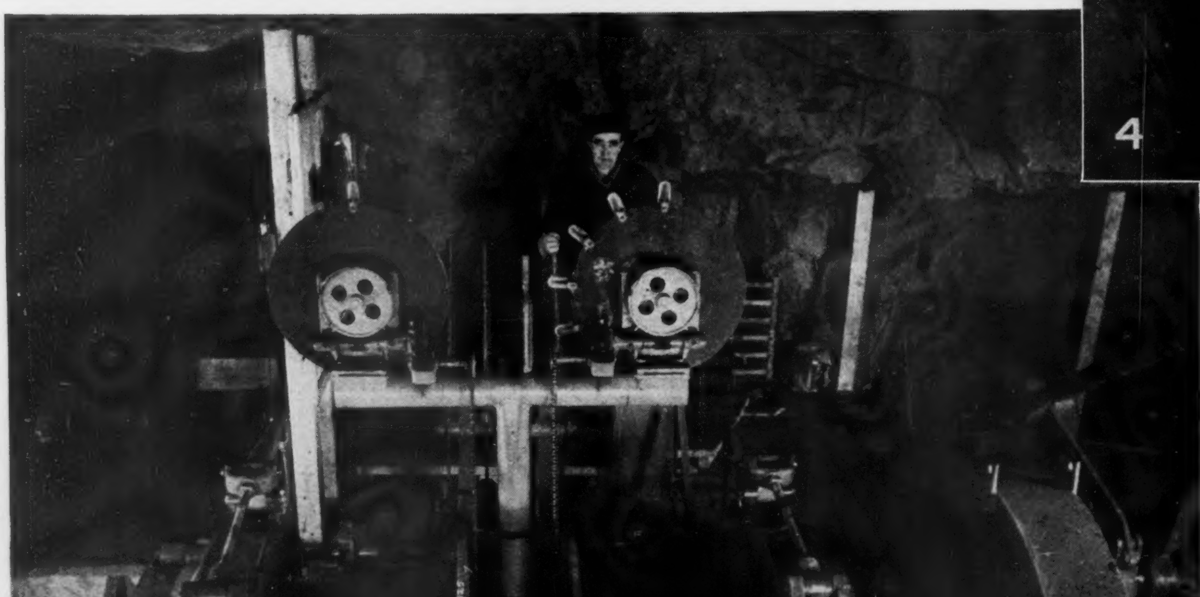
Acknowledgment is made to the management of the Oliver Iron Mining Company for permission to use and publish the data given.

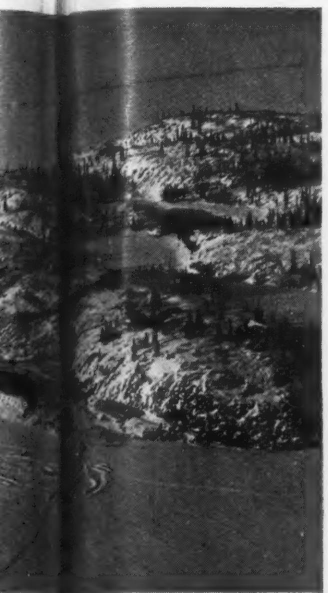
Scenes at

Eldorado Gold Mines, Ltd.









THIS group of pictures supplements the article on Canadian radium that we published in September. As the camera reveals, cold and bleakness prevail in the unbroken expanses above ground; but below the surface, where most of the work is done, fairly comfortable conditions exist despite the fact that frost penetrates the rocks to a depth of 320 feet.

No. 1 shows the midnight sun dipping and rising again. The picture was taken by Gilbert LaBine, discoverer of the ore deposits and now general manager of Eldorado's operations. It was taken by opening the lense of a stationary camera at fixed intervals a few minutes apart, thereby photographing the moving sun on one negative in 23 different positions.

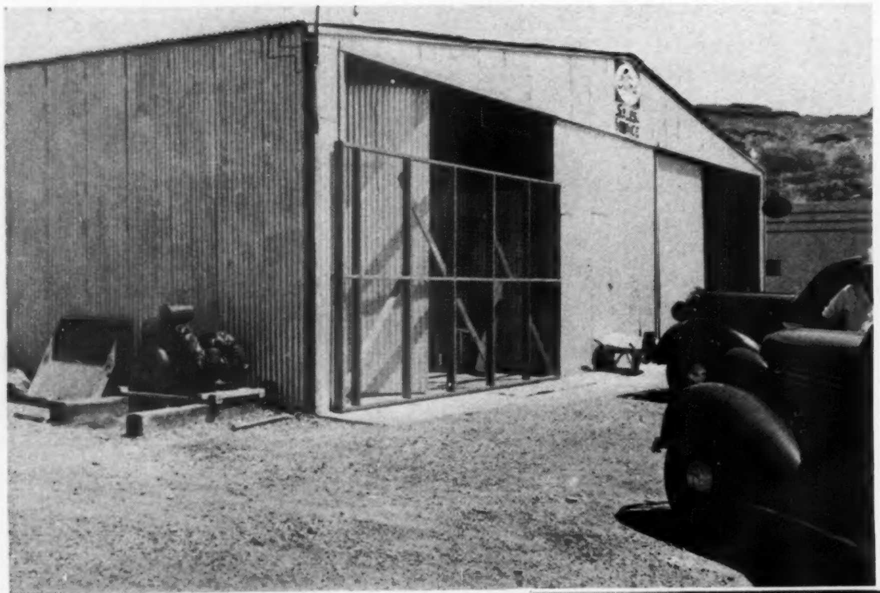
No. 2 is a winter aerial view of LaBine Point, with the mine and mill buildings in the foreground. No. 3 shows a Canadian Ingersoll-Rand hoist installed underground, and No. 4 a drilling crew with a drifter drill mounted on the arm of a column.

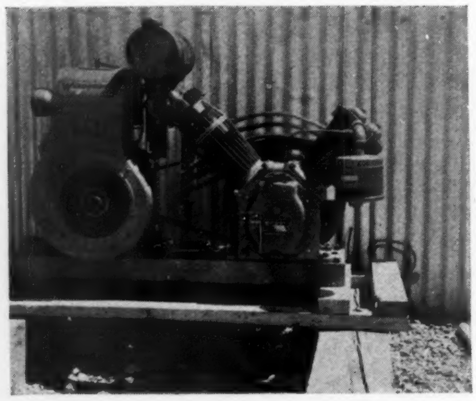
Pitchblende ore, which contains the radium and uranium, is readily recognizable, and high-grade pieces are sorted out in the stopes. Later, there is a further visual selection as the partly crushed ore passes over the belt shown in No. 5.

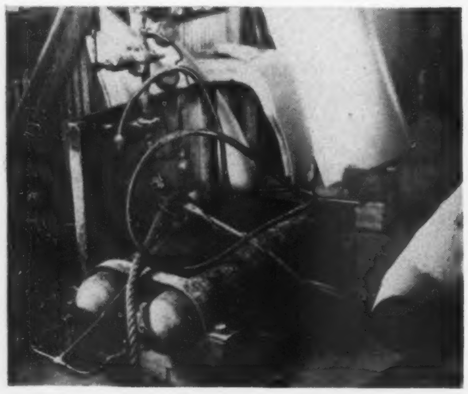
Eldorado miners are all young, strong, and healthy men, carefully chosen to withstand the Northland conditions. In No. 6 is a group of them leaving the cage that has lowered them to the 500-foot level.

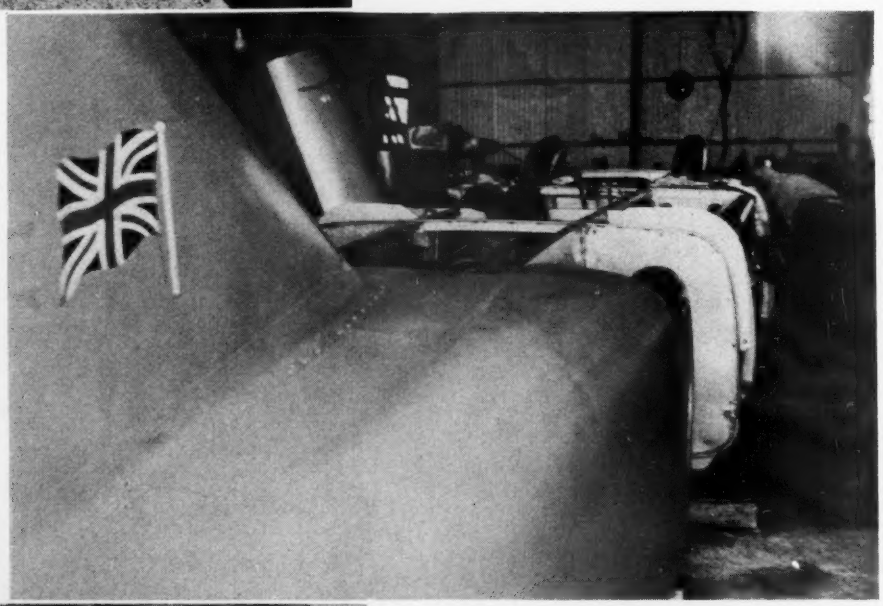
Most of the concentrated ore is shipped out by water during the brief summer; but at times the company's airplane is used to transport the precious cargo. No. 7 shows the ship being loaded.

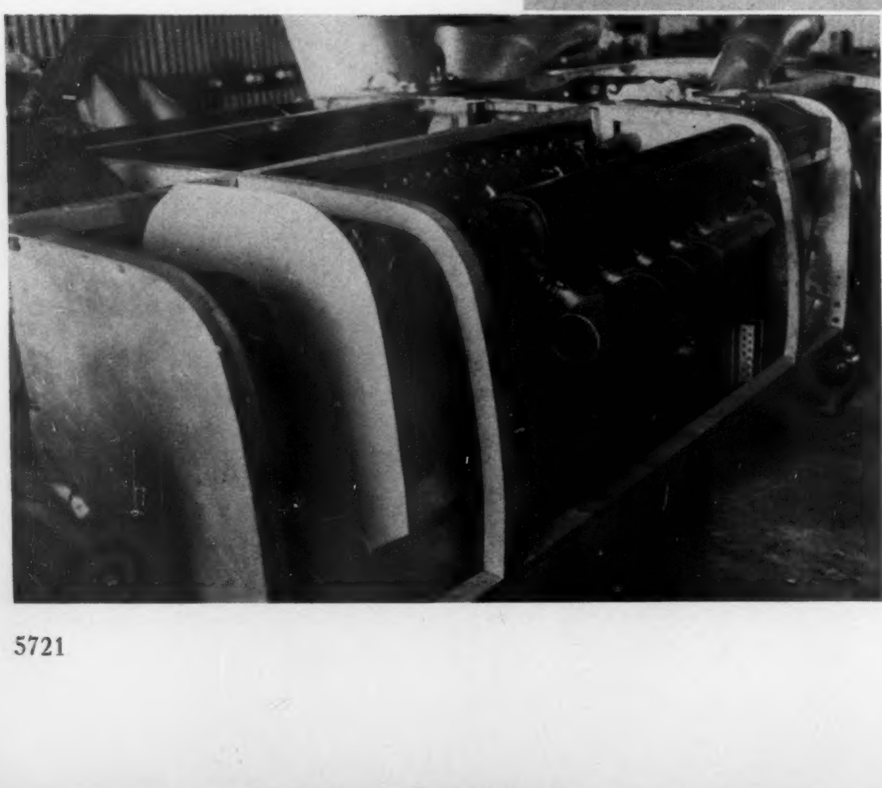
Starting the World's Fastest Automobile











TUNING UP THE CAR

The 7-ton "Thunderbolt," in which Capt. George E. T. Eyston, retired British Army officer, set a new world automobile speed record of 357.5 miles an hour on September 16, was started with compressed air. These pictures were taken a few days before his first two record runs in opposite directions over a measured mile on the salt flats of ancient Lake Bonneville, near Wendover, Utah. At the top left is the building in which the car was housed, with the compressor mounted on a temporary timber-skid base outside. At the top right is a close view of the compressor. It is an Ingersoll-Rand Type 30, two-stage unit driven by a 6-hp. Wisconsin gasoline engine and has a maximum discharge pressure of 1,000 pounds per square inch. The high-pressure air was stored in the steel bottles seen at the left center and was drawn from them into the engine cylinders for starting. The other pictures show the car with the engine hood removed and a close-up of the Rolls-Royce engine. This method of starting was used when the car was in the building: during the speed runs it was pushed by a truck.

Six Miles a Minute

THE fascinating grip that speed holds on the human race manifested itself a few weeks ago when people the world over followed with keen interest and somewhat bated breath the performances on the salt-flat shores of extinct Lake Bonneville in Utah, where the record for the fastest mile ever traveled in an automobile was reëstablished three times in as many weeks.

Automobile speed trials are not new to Bonneville, but ordinarily only one aspirant for new honors is there at a time. This year there were two, and the spice of competition gave added zest to the revel of fleetness. Both drivers were Britons, and as one of them had set the previous best mark, England was bound to retain the mythical blue ribbon for speed on land regardless of what happened.

In the end, the laurels remained just where they had been—in the possession of Capt. George E. T. Eyston, retired British army officer. But, as matters turned out, Captain Eyston acted wisely in crossing the Atlantic to defend his position, for his fellow countryman, J. R. Cobb, proved himself a worthy competitor. He succeeded in wresting the crown from Captain Eyston; but the latter recaptured it the very next day.

In setting the new record, Captain Eyston traveled a mile at the rate of 357.5 miles an hour—a speed that is almost beyond human comprehension. It is the equivalent of approximately 524 feet a second, which compares with a muzzle velocity of around 700 feet a second for a .45 caliber revolver and 400 feet for a field-howitzer shell. It is almost half as fast as sound travels through the air. It makes the best efforts of human runners seem like a snail's pace. The record for 100 yards on the cinder path is 9.4 seconds, whereas Captain Eyston's 7-ton mechanical juggernaut covered the same distance in about 0.57 second. In other words, he negotiated almost a mile in the time that the fleetest foot racer could run 100 yards.

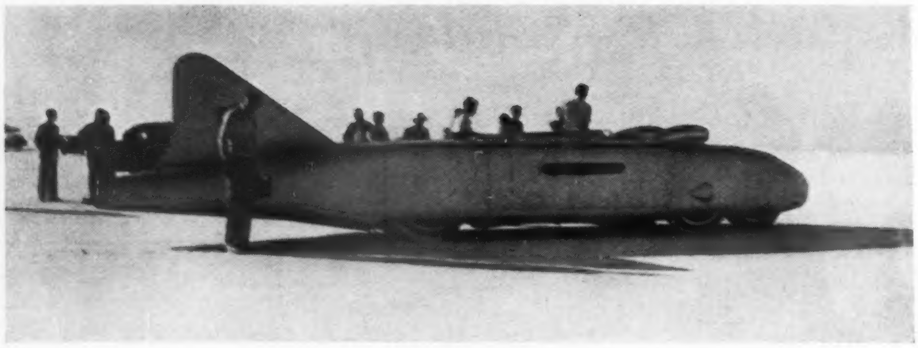
Captain Eyston is responsible for increasing the speed over a measured mile by almost a mile a minute. Prior to his first visit to Bonneville the record was 301.13 miles an hour. This was set by Sir Malcolm Campbell in his *Bluebird* on September 3, 1935. In preparation for his assault upon that mark, Captain Eyston built the *Thunderbolt*, a 4,000-hp. machine driven by two 12-cylinder Rolls-Royce engines, geared together. Nearly a year was required to construct it. On November 19, 1937, Captain Eyston drove it both ways over a mile course at Bonneville at an average speed of 311.42 miles an hour.

Not content with that performance, he returned to England and set to work to make the car faster. Last summer he brought the improved *Thunderbolt* back to America. On his first trial runs he went so fast that the electric-eye timing device set up by the American Automobile Association failed to "see" the car, so the effort went for naught. To obviate this difficulty, the machine was painted black before the next attempt. Early in the morning of August 27—a time of day chosen for all runs to insure a dry ground surface—he sped over the mile stretch at the rate of 345.49 miles an hour.

In a brief radio talk following this run, Captain Eyston said that he had not forced either himself or the car to the limit of safe performance, for, as he put it, "we may have to do this all over again." He was referring to the presence of Cobb and announcing his intention to try again should his fellow countryman better the mark he had just set. He spoke advisedly, for Cobb sent his machine, *Railton*, across the salt beds on September 15 at a speed of 350.2 miles an hour. The car, which is lighter

READY TO GO

Captain Eyston standing in the driver's compartment just before unleashing the 4,000 horse power of his 24-cylinder "Thunderbolt." During the speed runs, the car emitted a streamer of black smoke 3½ miles long. It passed the timing station simply as a "swish," the sound of its passing following about half a mile behind.



ON THE SALT FLATS

The wheeled projectile ready for a run. Built somewhat on the lines of a whale, it has a vertical, rudderlike tail piece that helps to give it stability at high speed. The size of the human figures conveys an idea of the dimensions of the car.

than Captain Eyston's, had been designed by Reid Railton of England for a speed of 350 miles an hour, so it attained that goal on its first run. Captain Eyston had remained on the ground to see what Cobb would do. Knowing that the *Thunderbolt* had some reserve power that had not been called on, he went out the following morning and set the present record of 357.5 miles an hour.

On his runs, Captain Eyston covered about 13 miles in all, requiring 6 miles to attain maximum speed and the same distance to bring the wheeled projectile to a halt. It is the slowing down of the machine from its terrific top speed that constitutes the greatest hazard on such runs, Captain Eyston states. Cobb's lighter car reached its maximum speed in 4½ miles, and ran about the same distance after passing the measured mile before coming to a stop. Like the conventional automobile, Captain Eyston's car is geared for only three forward speeds. It can go 80 miles an hour in first gear and 200 miles an hour in second gear.

A peculiar feature of driving of this kind is that preliminary or test runs are seldom made, and the driver has no way of accustoming himself to handling the car at high speed. In Captain Eyston's case, no test of the *Thunderbolt's* speed was made abroad, and only one run at comparatively low speed was made at Bonneville prior to the official trials. Captain Eyston, however, was a veteran automobile speed driver, so far as longer runs are concerned, years before he ever considered going after the mile record. Four times he had held the world record for an hour's driving from a standing start, his best mark being 162.5 miles. On two occasions he had held the 24-hour record, having covered 3,575 miles, or an average of 149 miles an hour, in his fastest run. He also had held the 48-hour record, with a run of 6,555 miles, or an average of 136 miles an hour. This total is almost equal to the distance from New York to Tokyo. The 24- and 48-hour runs were made with a relief driver. Captain Eyston is the present holder of the 2,000-mile record, with an average speed of 163.75 miles an hour; the 12-hour run, with an average of 163.68 miles an hour; and the 3,000-kilometer (1,864-mile) run, with an average of 163.49 miles an hour. His elapsed time for the 2,000 miles was twelve hours and nineteen minutes. These marks were set on November 3, 1937, on a 10-mile circular track at Bonneville, and were made in *Speed of the Winds,* a sister of the *Thunderbolt.*

In making his mile run this year Captain Eyston shattered the previous record for a kilometer, which is the established measure of distance in many parts of the world. On August 27 he became the first man ever to drive a car at a speed of 500 kilometers, or 310.68 miles, an hour. His September 16 run was at the rate of 575 kilometers an hour.

At top speed, the eight 48-inch wheels on *Thunderbolt* made 45 revolutions a second. The terrific strain that this imposed on the tires is evident. Tires were changed after each run, and to make certain that he would have an ample supply, Captain Eyston brought 70 Dunlop tires with him from England. He also brought sufficient quantities of Wakefield "Castrol" oil and British Petroleum Company *spirit* to see him through the speed trials. The latter is a high-octane gasoline of a grade ordinarily used in airplanes A crew of eight men, including several skilled mechanics, accompanied Captain Eyston to America.

Although the speed of these runs is many times greater than that reached in ordinary road driving, Captain Eyston expressed the belief that such record breaking in specialized machines is of great value to the advancement of automobile design generally both from the standpoint of safety and efficiency. For example, by building tires that are able to withstand speeds of nearly 6 miles a minute, manufacturers learn how to make tires that will not blow out at ordinary road speeds. Similarly, the lessons learned from the use of finer steels and lighter aluminum alloys and the building of a car like the *Thunderbolt* with precise workmanship inevitably lead to improvements in the construction of automobiles intended for the average driver.

Compressed air played a small but important part in the speed runs. It was introduced into the cylinders of the engine at 1,000 pounds pressure to start the car. The compressor and charging bottles employed for this service are illustrated on a preceding page. The same compressor furnished air for the tires, which were inflated to a pressure of approximately 100 pounds. Incidentally, it was used by Captain Eyston in 1937 and, accordingly, has figured in the breaking of the mile record three times.

Captain Eyston sailed for England on October 6, undecided as to whether he will return to America next year for another record attempt. He indicated that he considers 360 miles an hour the maximum speed that can be attained with any automobile that it is now possible to build. The *Thunderbolt* did not accompany its owner. It will be exhibited at several automobile shows in Canada before it is shipped home.

Jackling a Titan of the Copper World

AS THE directing head of various copper companies, Col. Daniel C. Jackling has been responsible during the past 33 years for the production of 9,500,000,000 pounds of copper. This has involved the mining of 1,000,000,000 tons of material, of which 460,000,000 tons was ore. These facts were brought out at a recent meeting of the Nevada and Utah section of the American Institute of Mining Engineers of which Colonel Jackling is president.

A native of Missouri, where he was born in 1869, Jackling was educated at the State Normal School and the Missouri School of Mines. He taught chemistry and metallurgy at the latter institution from 1891 to 1893, and then entered upon his mining career as a chemist and metallurgist at Cripple Creek, Colo. From 1896 to 1900 he was in charge of the construction and operation of metallurgical works for the Consolidated Mercur Gold Mines at Mercur, Utah. In 1903 he organized the Utah Copper Company, which is renowned for the magnitude of its open-pit operations.

In 1915, William H. Taft, then president of the United States, was traveling across Utah with Jackling and Tasker L. Oddie, Nevada mining engineer who afterward became United States senator from his state. Taft spoke of the Panama Canal construction and mentioned the great cuts it required. Thereupon Jackling produced figures showing that the excavating operations in his mines exceeded those of the canal.

Colonel Jackling (the title was bestowed upon him by two western governors—James H. Peabody of Colorado and William Spry of Utah) is president and a director of the Utah Copper Company, the Nevada Consolidated Copper Corporation, and the Butte & Superior Mining Company. He is chairman of the operating committee and a director of the Kennecott Copper Corporation and a director of the Braden Copper Company.

BETTER USE OF METALS

SO FAR as this generation and several that are to follow are concerned, there is no need to fear a shortage in our supply of the commoner metals. Although no country is self-sufficient in reserves of all commercial and industrial metals, the nations, collectively, are well provided; and, under normal conditions of international trade, exchanges are effected that insure all countries an ample supply to meet their needs. From the near view, then, there is no cause for alarm.

At long range, however, the outlook is different. Large deposits of our key metals still remain in the ground in the form of ores; but the supply is not inexhaustible. As a matter of fact, during the past half-century, when the trend towards the use of machinery became marked, some economists predicted that our mineral stores would soon be depleted. Their fears were premature, because they did not foresee the great technological advances that were to bring about a more economical use of metals. Nor did they envision the discovery of additional ore bodies. Together, these developments have given us security for many years to come, but, nevertheless, it is prudent to think seriously of conservation.

Broadly speaking, conservation may be regarded as the efficient use of the world's resources. No country should feel privileged to mine its ores without restriction just because it has rich stores of them. On the contrary, it should feel that it is holding its mineral resources in trust for the benefit of all nations and should, accordingly, develop them and utilize them with economy.

Fortunately, conservation does not apply solely to the production of virgin metals. With few exceptions, the metals that man uses most are not destroyed in service and can be recovered and employed over and over again. Thus, one important phase of economy has to do with the recovery of scrap and waste metals and their use in conjunction with or instead of metals direct from ores. There was a time when secondary metals were looked at askance; but that was before metallurgy had learned how to control the necessary treatment processes and to make a product that would be reliable.

There is still another avenue of conservation open to us, that having to do with the use of proper materials for given purposes. The metallurgist has given us and is continuing to give us innumerable alloys that have definite advantages for certain services. The engineer is daily finding ways to apply these alloys so that the most can be obtained from them. Here is practically an untouched field that offers great opportunities for practicing conservation. Obviously it is wasteful to employ a large quantity of iron for any purpose that can be better served by a small amount of an alloy.

The whole subject is well summed up in the British publication *Metallurgia* in the following words: "True conservation of metals, therefore, is not only concerned with the prudent use of the natural resources, but also with the constant use and re-use of that part of production which is not dissipated in service and the efficient use of combinations of metals in the form of alloys, which give longer service and resist more successfully the effects of time and service. Just as it is an economic sin to use primary metals when less expensive secondary metals or scrap will serve equally well, it should be a sin to disregard the discoveries and developments of the metallurgist in providing new and improved metallic alloys which possess greatly increased strength, give longer service and resist more successfully the dissipative effects of atmosphere, chemical contact, high temperatures, etc., than the materials in more general use today. It is this latter aspect of conservation which offers scope for the less extravagant use of raw materials."

FOR SAFER HIGHWAYS

MANY proposals for superhighways are put forward on the ground that they would increase safety in driving. Probably they would be of some help; but it is doubtful if the mere building of wider, easier-graded roads would notably reduce the number of accidents. More often a driver and not the highway is at fault. All main arteries should, of course, be brought up to a certain standard of construction—something that it would take many years to accomplish. But the part that the human element plays ought to be carefully evaluated before existing good roads are widened solely on the supposition that that might materially reduce mishaps.

R. E. Toms, chief of the division of design of the U. S. Bureau of Public Roads, believes that our existing highways are safe for 98 per cent of the motorists. He opposes any movement to build so-called foolproof roads in a futile attempt to make them safe for the 2 per cent of reckless, incautious drivers that cause most of the accidents. Instead, he says it would be better to spend the money to keep these unsafe operators off the highways. It is not possible to design a road that will correct the mistakes of the driver, according to Mr. Toms.

Surveys disclose that about 3 per cent of the drivers using our highways are involved in all the accidents resulting in personal injuries. As it is unreasonable to assume that both are to blame whenever two cars figure in a mishap, probably not more than 2 per cent of all drivers are actually at fault. In other words, 49 out of every 50 find the present roads amply safe. Undeniably, we need more highways; but their construction should be based more on traffic needs than on the theory that they will appreciably reduce the number of accidents. As Mr. Toms points out, engineering ingenuity can bring about a higher factor of safety on our roads; but it can never entirely compensate for human error and the possibility of mechanical failure.

This and That

Flat Tire Kink

Even though the old days of "get out and get under" no longer harass the motorist, no one has yet found a way of preventing tires from suddenly going flat at the wrong time. A device recently developed does, however, make it possible to escape the drudgery of changing tires on the road, provided the leak is a small one. The principle is very simple—the motorist merely transfers half the air from a spare tire into the deflated one and, usually, can then proceed as far as a service station *sans* grease spots.

* * *

China's Unique Dollar

The only coin in the world picturing an automobile is a rare silver piece that is legal tender in the interior of China. Only a few of them have ever reached the United States, and most of those are in the hands of collectors. This "automobile dollar," as it is known in China, bears the likeness of an American-made sedan and commemorates a notable feat of transportation that was carried out in China in 1927. In that year a machine built in Detroit was transported, piece by piece, to Kweiyang, capital of the mountain province of Kweichow. It was necessary to convey it by bamboo litter, by boat, by rail, and on the backs of coolies, in turn. When the car had been assembled and placed in operation, the governor of the province was so impressed that he ordered the mint to strike a coin in observance of the occasion.

* * *

Power at Low Cost

A new steam-driven central station being erected at Oswego, N. Y., by the Central New York Power Corporation is expected to produce a kilowatt-hour of electricity from 0.85 pound of coal. Twenty years ago the average central station burned 3.3 pounds of coal per kilowatt-hour of power. An 80,000-kw. turbine generator is being built for the new plant. It will be of the condensing type, and the operating steam will be introduced at 1,200 pounds pressure and heated to 900°F. This temperature is hot enough to burn wood, and special alloys will be employed in the turbine to resist it. The steam will pass through the turbine casing in about 1/20 second, and during that brief time its pressure will drop from 1,250 pounds to 1 pound and its temperature will fall from 900° to 79°. Hydrogen will be the cooling medium for the generator. Its use, instead of air, will reduce the windage loss by 10 per cent and, consequently, add 500 kw. to the output of the unit. The boiler will weigh 1,500 tons, be comparable in size to a 9-story apartment house, and will develop 850,000 pounds of steam an hour—equivalent to evaporating 54 barrels of water a minute. It will contain 98½ miles of tubing; pulverized coal will be burned at the rate of about half a carload an hour; and more than 17,654 cubic feet of air at a pressure equal to that of a 12-inch water column will be introduced each minute to aid combustion.

* * *

Prospecting Goes Modern

At a recent gathering of mining men at the University of Washington there was exhibited a motorized outfit for prospectors that would doubtless make a desert rat of the old days green with envy. The 1938 equipment consists of a truck-drawn trailer. The truck contains complete equipment for prospecting, including a rock drill and a small compressor to furnish air for running it. The trailer was fitted out with a small assay laboratory, a kitchen with a gasoline stove, and a bed with real springs and a mattress. It was assembled by a Western concern.

* * *

A City of Gas Stations

Because it has one service station for every 42 cars and one gasoline pump for every fourteen cars, Fort Smith, Ark., has been called the city of gasoline stations. The reason for this seeming superabundance of motorists' facilities is found in the local tax situation. Arkansas, with a gasoline tax of 6½ cents a gallon, adjoins Oklahoma, where the tax is only 4 cents a gallon. This differential was sufficient to cause many Arkansas car owners to cross the border to replenish their gasoline tanks. To prevent this, and thereby keep the tax revenue at home, the Arkansas legislature passed a law permitting gasoline stations within 3 miles of the border to pay a reduced tax. Forth Smith is in this zone and sells gasoline to motorists from many miles away.

* * *

Horse Car Haven

Horse cars are still the sole type of common carrier on Douglas Promenade on the Isle of Man, which thus bears the distinction of being the seat of the only regular transport operation in the British Isles that is dependent on horses. Motor buses are used in other parts of the island; but the residents are sentimental about their horse cars on this one route, so much so in fact that, when a newspaper called for an expression of opinion, 97 per cent of those replying favored retention of the "hay-burners." Forty-six cars, fitted with roller bearings to make the lot of the horses easier, operate over the 1¾-mile stretch. There are 140 horses, each one named and each having its own stall. To assist them in gripping the hard surface of the roadway, they are shod with rubber. This unique line grows in popularity steadily, having carried 2,811,451 passengers in 1937 as compared with 2,116,000 in 1932. The total revenue last year was £27,723 and the profit £9,500, or about $45,500.

* * *

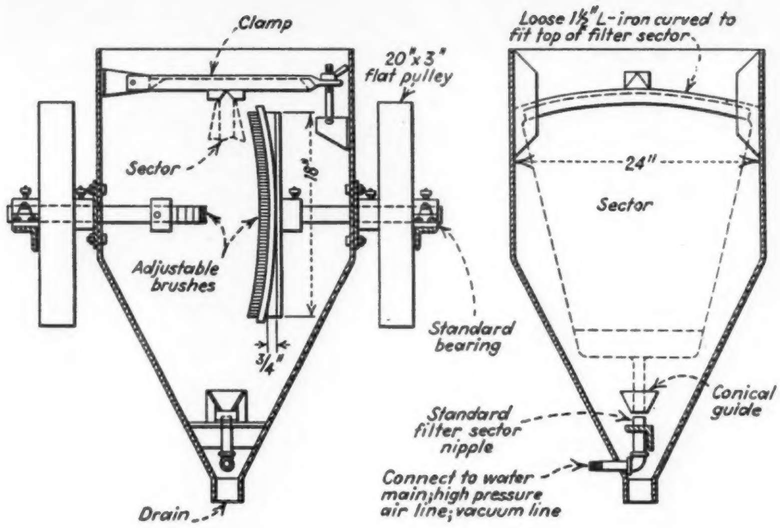
Better Incandescent Lamps

Krypton and xenon, gases which are known to add materially to the efficiency of incandescent lamps, have been obtained heretofore as a by-product in the manufacture of oxygen and hydrogen, but in such small amounts as to make their use for the purpose mentioned prohibitively costly. Recent reports from France have it that La Societe L'Air Liquide has developed and patented a procedure by which these gases can be extracted from the air, in which they are present in very minute quantities, on a scale sufficient to meet the needs of the millions of incandescent lamps produced annually. The necessary apparatus has been set up at the company's Boulogne plant, and has an hourly capacity of about 1,060,000 cubic feet of air compressed to approximately 10 pounds. The power consumption per liter (1.056 quarts) of krypton and xenon, mixed in the proportion in which they are found in the atmosphere, is estimated at 40 hp-hrs.

* * *

Liquid Air Drives Engine

An engine of a revolutionary type was put through its paces not long ago in Japan where it is hailed as an engineering achievement of oustanding importance. The unit is designed for liquid-air drive at a temperature of −218°F. It was invented by Y. Shibukawa, chief engineer and founder of the Shimizu Low Temperature Research Laboratory, and consists essentially of a liquid-air container, a pump, a vaporizer, a prime mover, and a liquefier, for the engine operates on the closed cycle and only enough fuel is added from time to time to compensate for any loss of liquid air through leakage. A small unit was installed aboard a 27-foot-long boat for test purposes and is said to have propelled the craft at a cruising speed of 4.6 knots for 1½ hours. With this proof that an engine can be run on the power latent in liquid air, a unit of several hundred horsepower is to be the next step in the development.



Wet Scrubber for Special Service

SPECIAL needs require special equipment, and they are often dealt with on the spot as they arise. A case in point is that of the Consolidated Mining & Smelting Company of Canada, Ltd., which was faced with the necessity of speeding up the maintenance—inspection and scrubbing—of the 6-foot-diameter continuous disk filters that handle its finished zinc concentrates. The problem was put up to the mill's mechanical department, and the result is a wet scrubber that fully meets the requirements.

The structural features of the unit are shown in the accompanying sectional drawings, which are reproduced through the courtesy of *Engineering and Mining Journal*. The scrubber consists of a square steel tank with a hopper bottom, and is designed to clean the filter sectors with water and compressed air. The sector to be conditioned is held in position by a clamp in the top of the tank and by a conical guide and a nipple at the bottom. Scrubbing is done with two adjustable brushes which are mounted on steel shafts driven through pulleys by a small reversible electric motor. Both brushes turn in the same direction and make 60 rpm.

Water and high-pressure air are admitted through one connection at the bottom, one or the other being supplied as desired by a suitable valve arrangement. Obviously, the air pressure must be carefully regulated, for otherwise the water would back up in the main. After the brushes have run a certain length of time their direction is reversed, and when the sides of the filter sector are believed to be clean, the water and air are exhausted, the brushes stopped, and the sector, itself, drained by means of suction, the connection at the bottom then serving as a vacuum line.

Apparatus for Testing Diesel Engine Nozzles

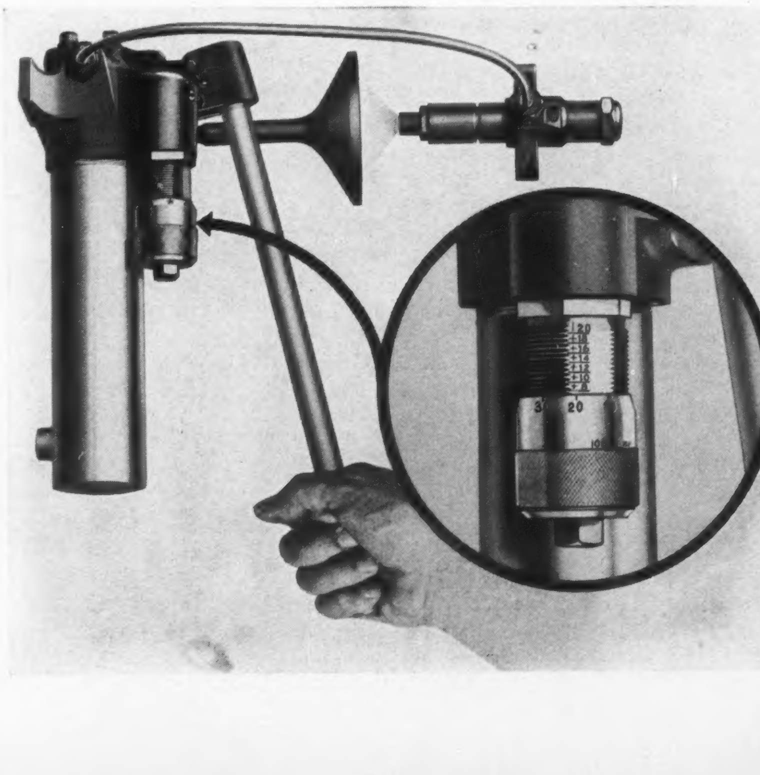
ROUTINE maintenance of diesel engines on heavy automotive vehicles should include nozzle testing, according to experts, as satisfactory performance depends largely on uniform and proper fuel injection. When nozzles become clogged, the spray delivered is not symmetrical, a common difficulty that may lead to all sorts of trouble, aside from wasting fuel and causing the engine to run at reduced efficiency.

In the Fuel Research Laboratories of the Waukesha Motor Company has been developed a tool with which, it is claimed, every standard make of injection nozzle can be easily tested and accurately adjusted. It is called the Waukesha Diesel Nozzle Tester and was designed for both laboratory and service-station use, as well as for owners of fleets of trucks, buses, etc. It consists mainly of a hydraulic pump element operated by a long hand lever, of a horizontal cylinder or reservoir directly below the lever, of a funnel, and of a high-pressure tube with which the unit is connected to the nozzle to be checked.

The fuel oil used for testing is of course the same as that supplied the engine, and is admitted into the reservoir through the funnel. From the reservoir, which has a capacity of approximately a pint, it is delivered to the pump, passing first through a filter to prevent foreign matter from reaching the former, and is thence forced through the tubing into the nozzle, which discharges into the funnel and thus feeds the oil back into the reservoir for recirculation.

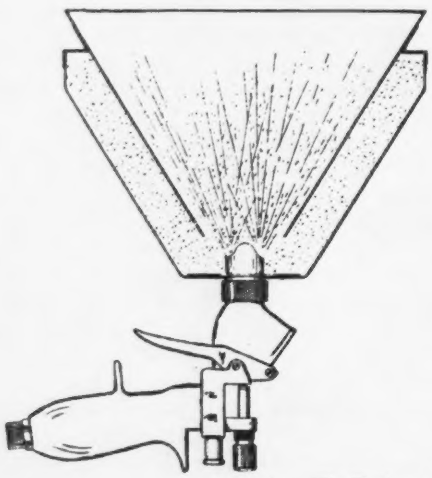
A balanced by-pass valve connects the delivery passages in the pump head with the return port leading to the reservoir, and by controlling the spring tension on this valve the pressure in the nozzle line can be adjusted with accuracy for any required nozzle setting. This is effected by means of the knurled micrometer head shown in the inset in the accompanying illustration. Although it is calibrated for 10-pound settings, 5-pound settings can be readily estimated because the markings are liberally spaced around the barrel. One complete turn of the head changes the discharge pressure 100 pounds.

According to the manufacturer, the apparatus makes it possible readily to determine the spring pressure, quality and pattern of the spray, condition of the valve seat and amount of dribble or leakage, stuck needle valves, and other irregularities that can be corrected without difficulty once they are detected. And it is said that ordinary wear, even after testing tens of thousands of nozzles, does not affect the accuracy of the instrument. It weighs less than 20 pounds, complete, and its use does not call for special skill.



Industrial Notes

Two Englishmen have received a patent on an air-spray gun that serves the double purpose of applying paint and blowing granulated cork on to the freshly coated surfaces. The object of the latter is to prevent condensation of moisture on metal



Courtesy, The Engineer

walls such, for example, as the interior plating on shipboard. The cork is carried in a conical hopper mounted on top of the pistol and, as the accompanying drawing shows, is forced into and up through a cone set inside the hopper. The apparatus is designed to apply the materials separately or simultaneously.

In Argentina, South America, there has recently been put in service by the Department of Agriculture a vegetable disinfecting plant. The produce is treated by hydrocyanic and carbon-disulphide gas in steel vacuum chambers each of which has a capacity of approximately 1,765 cubic feet.

Corning Glass Company has developed a gauge glass that does not have to be seen at close range to read it. It is made of Pyrex and characterized by a transparent red line that appears to expand and to impart a red color to all that part of the tube below the water line. The glass comes in lengths up to 24 inches and from ½ to 1 inch in diameter. It is machine drawn and is said to remain clear and to retain its dimensions and thermoshock resistance in service.

If you are among the fortunate who can afford a well-appointed office with scatter rugs on the floor, be sure they are skidproof lest your best customer take a tumble. A new material to keep the rugs "put" and thus to avoid accidents has lately appeared on the market. It is called Rug-Kling, and is an open-work weave of rubber-coated fiber weighing from 0.45 pound to 1.36 pounds per yard. It comes in three grades and colors—gray, green, and tan in ¼-, ½-, and ¼x½-inch mesh, respectively—and in two widths, 32 and 48 inches. The latter is woven with a selvage through the center so that it can be cut into 24-inch strips. Collord, Inc., is the manufacturer.

Here's a hint from the Milwaukee Electric Railway & Light Company that may prove helpful to others that are faced with the same problem—the cleaning of windows of buildings or cars after spray painting. Where much work of this sort is done it is the practice to protect the glass with a coating of some kind. Instead of calcium chloride, the company in question now uses a mixture of glycerine and whiting which, it is found, acts the same under all weather conditions, does not run down on the surfaces to be painted, and makes it possible to clean the windows with much less time and effort, thus reducing breakage.

For handling oil under pressure, Chicago Metal Hose Corporation has developed a flexible metal tube with three protective layers. In contact with the metal are several thicknesses of cellophane, which conforms to the contours of the spiral corrugations so as not to reduce longitudinal flexibility. Next comes a cover of Neoprene, a vulcanized synthetic rubber; and the outer casing consists of a metal braid. Called Avioflex, the tubing is made in sizes ranging from 5/32 inch to 1¼ inches inside diameter.

What is said to represent a departure in transmission belting for sewing and other types of light machinery has been announced by the Sudbury Laboratory. It is a patented round belt that is really round and therefore contacts the full surface of the pulley, thus giving the belt great coefficient of friction. It is made of a composition the quality of which does not vary, and has a core of a flexible material that is much stronger than steel and does not stretch as much as leather. Simplicity of fastening and less maintenance also are included among the advantages claimed by the manufacturer for this belting. It is tied together: 2 inches or so of the core being exposed for the purpose.

Climate and topography were the principal deciding factors in selecting the location for the new milling plant of the Big Missouri Mine Corporation, Ltd. The property is in British Columbia, Canada, and situated on a steeply sloping ridge that offered no site free from the danger of snowslides in spring. It was therefore decided to place the mill underground in solid rock below the 2,350-foot level, or below the known ore bodies where no hoisting of ore would be required. The plant is situated within 6,000 feet of the camp buildings and is reached from there entirely by way of the underground workings. Exclusive of diamond drilling, the digging of the pilot tunnel, and other expenditures incidental to the preparatory work, the excavating of the mill involved a cost of $117,074. It has been in operation since March of this year and is treating more than 500 tons of gold ore daily.

For scale and deposit removal, as well as prevention, a British firm has developed two products for which it makes exceptional claims. Clensol, as such, is intended for removing scale from the jackets and circulating-water systems of internal-combustion engines. It is in the form of a solution with which the system is filled after draining off the water, an opening being left at the top to permit the escape of the gas that is generated by the scale as it decomposes. For thorough cleaning it is left in the jackets for a few hours. With the exception of aluminum and zinc, it is noninjurious to metals. For the prevention of scale in boilers there is Clensol Boiler Water Purifier. It is said to soften any scale that may be present at the time of its introduction and to obviate the formation of fresh deposits. This material comes in readily soluble bricks which are simply put in the boiler feed water. It is guaranteed not to contain any deleterious ingredients.

"Stick around! They dug up a couple of nice bones about this time yesterday."